

IN THIS ISSUE

Last year we published Garrett Crow's article updating and revising Emma J. Cole's 1901 *Grand Rapids Flora*. That was the initial entry in a comprehensive project by Crow and several others to re-examine the flora of the Grand Rapids area in western Michigan and its history. The second installment in this project, a biography of Emma J. Cole by Julie Stivers and Garrett Crow, forms the first article in this issue. Concentrating on Cole's career as a school teacher and her life's work in preparing the *Grand Rapids Flora*, the authors also discuss her connections within the Grand Rapids community and her collaborations with former students and other botanists. All of this is illuminated in four extensive appendices that reproduce the texts of many letters between Cole and her many correspondents.

In the second article, Anna Bowen, formerly a student at Albion College in Albion, Michigan, and Dan Skean present a flora of the Ott Biological Preserve in Calhoun County, Michigan, which updates an original floristic list for the Preserve made by William Gilbert between 1946 and 1954. In addition to an annotated listing of the flora, Bowen and Skean provide a detailed human history of the Preserve, including the several years during which it served as the nature center for Albion College, describe the natural communities of the preserve and their recent ecological history, including the increasing prevalence of non-native and invasive plant species, and perform floristic quality assessments.

There is an aura of mystery surrounding one of the iconic plants of the Great Lakes area, *Thismia americana*, that derives from its great rarity, its history of having been discovered by a botany student in the early years of the twentieth century, its disappearance within a few years, never to be seen again, its largely subterranean habit with only the surface of its flower emerging at ground level, and the lack of near relatives anywhere else in North America. These factors have combined to suggest to some that the purported discovery of *Thismia americana* in the Chicago area was actually a hoax. Gerould Wilhelm and Laura Rericha, authors of the recently published magnificent *Flora of the Chicago Region*, examine this history, describe the history and circumstances of the discovery of this species and the numerous attempts to relocate it in suitable habitat, and present cogent reasons why its discovery cannot be a hoax but rather that *Thismia americana* is a genuine, though likely extinct, element of the Great Lakes flora.

The discovery and recording of "big trees" has long been an interest of the Michigan Botanical Club. In this context, a "big tree" is the largest known individual of a species, either in a state or other jurisdiction, or worldwide (the terms "state champion" or "national champion" have also been used). This journal has published a complete list of Michigan big trees and shrubs (42: 3–46, 2003) as well as numerous shorter articles describing individual big trees of Michigan. In this issue, Susan Fawcett and Anton A. Reznicek describe a rather unusual find: the largest known individual, a tree, of a species—*Taxus canadensis*—that normally grows as a much smaller shrub.

It is well known that numerous species occur in the southern Great Lakes area, especially in southwestern Michigan and northwestern Indiana, that are disjunct from their main distribution in the southeastern coastal plain. Scott Namestnik describes the discovery of a new station of one of these disjuncts, *Rhexia mariana* var. *mariana*, in Porter County, Indiana, near the southern shore of Lake Michigan, its first record for northern Indiana, though it had previously been known from a few stations in western Michigan. In addition to detailing the discovery itself, Scott provides assistance in distinguishing this rare species from the other species of *Rhexia* known in the Great Lakes area, *R. virginica*, as well as from numerous other species of *Rhexia* in the southeastern United States.

—Michael Huft

EMMA JANE COLE, WEST MICHIGAN'S LATE-19TH CENTURY BOTANIST: A BIOGRAPHICAL SKETCH

Julie Christianson Stivers

645 Parkwood St. NE, Grand Rapids, MI 49503
jlcstivers@gmail.com

Garrett E. Crow

Visiting Scholar, Department of Biology, Calvin College
3201 Burton SE, Grand Rapids, MI 49546-4403
Adjunct Researcher, Michigan State University Herbarium
Professor Emeritus, University of New Hampshire
garrett.crow42@gmail.com; gc25@calvin.edu

ABSTRACT

Emma J. Cole (1845–1910) published *Grand Rapids Flora* in 1901, which catalogued the vascular plants growing in the vicinity of Grand Rapids, Michigan. As a teacher of botany at Central High School, and as the curator of the herbarium of the Kent Scientific Institute, she saw the need for an up-to-date account of the plants of the area to engage her students in the study of systematic botany. She engaged in intensive botanical collecting during the years 1892 to 1899 by horse and buggy, and, with the help and encouragement of various high school students of botany, former teachers, and some local botanical enthusiasts, she was able to compile a thorough record of the plant species growing without cultivation within 16¼ townships, comprising 585 square miles, centered on Grand Rapids. Throughout her research, she was in correspondence with B. L. Robinson and M. L. Fernald, both of the Gray Herbarium at Harvard University, who were then preparing a new 7th edition of *Gray's Manual of Botany*, as well as with C. F. Wheeler and W. J. Beal, who were botanists at Michigan Agricultural College (now Michigan State University) engaged in research on the flora of Michigan. She not only had a significant impact on botany in West Michigan, but became a cherished mentor to many students. When Cole's *Grand Rapids Flora* was completed, she turned her attention to studies of *Crataegus* (hawthorns), collaborating in those studies with C. S. Sargent, Director of the Arnold Arboretum at Harvard University. She also travelled widely in northeastern and western North America, botanized in Europe on a three-and-a-half-month trip, and visited Cuba, collecting botanical specimens all along the way. By her passion and pursuit of a professional vocation in science during a time when it was very difficult for women to do so, she inspired, and continues to inspire, botanists both amateur and professional, who love the natural world and wish to preserve it. In 2007, she was inducted into the Michigan Women's Hall of Fame, recognized for her life's work and her contributions to science and education. And her *Grand Rapids Flora* continues to provide a critical historical context and inspiration for us in our pursuit of knowledge of the Grand Rapids flora in the twenty-first century.

KEYWORDS: Biodiversity, biography, botanical history, Emma Cole, flora, Michigan flora, Grand Rapids Public Museum, herbarium, Kent Scientific Institute, plant specimens

INTRODUCTION

In the spring of 1901, a new botanical work, *Grand Rapids Flora: A Catalogue of the Flowering Plants and Ferns Growing Without Cultivation in the Vicinity of Grand Rapids, Michigan* (hereinafter "*Flora*"), was published by

Emma J. Cole (1901). The *Flora* was widely distributed and well received nationally and internationally. Throughout her research on the *Flora* Emma corresponded with such distinguished botanists as W. J. Beal and C. F. Wheeler of Michigan Agricultural College (officially Agricultural College of the State of Michigan, now Michigan State University), B. L. Robinson and M. L. Fernald of the Gray Herbarium of Harvard University, and C. S. Sargent of the Arnold Arboretum at Harvard University. Sargent even named a species of hawthorn for her (*Crataegus coleae*), adding this delightful line at the end of the article in which the species was first described: “It is a pleasure to associate with this handsome shrub the name of its discoverer, Miss Emma J. Cole of Grand Rapids, Michigan, the author of *The Grand Rapids Flora*, and a careful and industrious student of the plants of central Michigan, where she has made a number of other important discoveries” (Sargent 1902a). This important botanical reference remains the most recent comprehensive account of the plants specific to the greater Grand Rapids area, and one that is still consulted by those with interests in local native habitats, the historical status of today’s State-listed rare and endangered plants, and the flora of the region in general (Crow 2017). Prompted by their use of Cole’s valuable *Flora*, David Warners and Garrett Crow of Calvin College, in collaboration with Bradford Slaughter of Orbis Environmental Consulting, initiated a project centered at the Calvin College Herbarium to reexamine the flora of the Grand Rapids area, with the intent of 1) identifying and accessing specific areas studied by Cole, 2) determining the impact of development on the flora as a whole, 3) reassessing specific localities Cole regarded as botanically significant, 4) discovering and inventorying other ecologically interesting sites within the area of Cole’s *Flora*, and 5) determining the current status of the rare plants tracked by Michigan Natural Features Inventory (2016) that were listed in Cole’s *Flora*.

Fortunately, the desire by the botanists to know more about the author of the *Flora* intersected with an effort by Julie Stivers to continue her biographical investigations on Emma Cole. Stivers (2007) had prepared the historical documentation for the nomination of Miss Cole submitted by the Greater Grand Rapids Women’s History Council to receive long-overdue statewide recognition for her contributions to education and science. Although highly praised in her time for her 26-year teaching career, her work merited re-examination and honor for its outstanding and pioneering contributions to science. On October 17, 2007, the 19th century Grand Rapids botanist and teacher Emma Jane Cole was inducted into the Michigan Women’s Hall of Fame for her achievements in the field of science and technology (Michigan Women’s Hall of Fame 2007; Stivers 2007).

In an editor’s footnote to Cole’s (1962) posthumously published article on Green Dragon, *Arisaema dracontium*, the late Dr. Edward G. Voss, author of the three-volume *Michigan Flora* (Voss 1972, 1985, 1996) and first editor of *The Michigan Botanist* (now *The Great Lakes Botanist*), noted that “Miss Emma J. Cole, author of the remarkably fine *Grand Rapids Flora* . . . evidently influenced a large number of people in the study of botany, and she will surely be worthy of a biographical treatment one day in THE MICHIGAN BOTANIST.” We here present that long-awaited biography of Emma J. Cole (Figure 1) along with a col-

lection of letters between Emma Cole and various correspondents (Appendices 1–4) that illuminate important aspects of her life and work.

THE EARLY YEARS

Emma Cole was born on January 23, 1845, in Milan, Ohio (Anonymous 1910). She and her family moved to Vergennes Township, about 11 miles east of Grand Rapids, sometime between 1855, when their name does not yet appear on the township plat map, and 1859, when her father Andrew Cole is listed as a Justice of the Peace (Chapman 1881). She attended Lowell Union School and Grand Rapids High School. She returned home to teach in the Vergennes district school for 4 years, while at the same time taking over the household duties for her invalid mother. She then taught in Union School in Lowell from 1869 to 1872, and afterwards at Greenville High School until 1876 (Beers 1900; Greeson 1910).

Emma had two brothers, John and Hugh, and a sister, Mary Cole Althouse, who died in 1873 at the young age of 25, as noted on her headstone at the Vergennes graveyard. After her father died in 1875 (Chapman 1881), Emma Cole, at the age of 31, left the safety and security of her rural life and, using her savings from teaching, enrolled in Cornell University in upstate New York in 1876 (Beers 1900; Greeson 1910). Cornell was chartered in 1865 as both a private university and as New York State's land-grant institution and Agricultural Experiment Station, to provide education in the arts, sciences, and literature as well as free tuition for students who pursued the full course in agriculture (Hewett 1905). Initially an all-male institution, Cornell matriculated its first class in 1868 and started admitting women in 1870—over the protests of many male undergraduates and faculty (Hewett 1905; Bishop 1962). Yet, on the day the University was formally opened, Henry W. Sage told the President: “When you are ready to carry out the idea of educating young women as thoroughly as young men, I will provide the endowment to enable you to do so” (Hewett 1905; Bishop 1862). By 1899, 367 female students were enrolled (Bishop 1962).

In the fall of 1877, just as Emma was to begin her sophomore year, her mother, Jerusha Cole, died, and she returned home (Anonymous 1877). She went back to Cornell in the fall of 1879 to continue her studies in botany and other subjects. Her transcripts from Cornell survive and reflect high marks through June 1880. The transcript entries end there, which leads us to believe that she left Cornell at the end of the 1879–80 academic year without having completed a degree (Cornell University 1993). She returned to Grand Rapids and joined the faculty at Central High School in 1881, where she taught for 26 years (Greeson 1910). The school was then located at Lyon and Barclay where Grand Rapids Community College now stands.

In her early days when she was assigned to the teaching of history, she wasn't a standout, according to a tribute written after her death by the Principal of Central High, William Greeson. But after taking over the botany department, she was often described as one of the most popular teachers at the high school (Greeson 1910).



FIGURE 1. Emma J. Cole as she appeared in the 1895 Yearbook, Central High School, Grand Rapids, Michigan. Source: Grand Rapids History & Special Collections, Archives, Grand Rapids Public Library, Grand Rapids, MI. Date of photo uncertain, possibly 1881 when she began teaching, as she appears young; the same photograph was used in all yearbooks seen.

Central High had for many years also housed the collections of the Kent Scientific Institute (KSI), thereby giving teachers access to the KSI natural history collections and library for instructional purposes and providing space for KSI's public meetings (Baxter 1891; Goss 1906). KSI, the precursor to today's Grand Rapids Public Museum, was established in January 1868 and operated under an agreement with the Board of Education of Grand Rapids; it was quickly earning a national reputation for its extensive collection and scientific undertakings. In his *History of the City of Grand Rapids, Michigan*, Albert Baxter (1891) wrote that KSI "has grown to be among the finest scientific collections in the West."

Emma was among the first female members of the Kent Scientific Institute. The minutes for November 6, 1891, mention her as chairman of the Botany Committee, and the Treasurer's book lists her faithful dues payments through 1908. In the meeting of February 2, 1900, she was elected a Vice President of the organization. Although two other women's names appear in previous governing lists in KSI annual reports, it is almost certain that Emma was the first woman to be paid for anything by the Institute. The governing and operating staff of the Institute served without salary, according to early records, but in the fall of 1891, the KSI Board of Directors voted to pay for Emma Cole's board during summers, thereby enabling her to complete the mounting and arranging of botanical material (Anonymous 1891). For an organization whose budget at the time seems to have averaged around \$100 annually, a stipend of \$10 each summer was a significant vote of confidence by her peers. They also voted to pay for all supplies required for mounting and processing the specimens for the Institute's herbarium (Anonymous 1892).

PREPARATION OF THE *FLORA*

Soon after Emma Cole began covering the botany curriculum at Central High School, she recognized the great need for an up-to-date account of the plants growing in the region of Grand Rapids. Wanting to engage her students in the study of systematic botany, Emma launched her *Flora* project in earnest in 1890. She envisioned a comprehensive listing of all the vascular plants growing within the city and the 16¼ adjacent townships (Figure 2), comprising 585 square miles. But even more, she endeavored to include information about blooming time, habitat preferences, and occurrences of uncommon or rare plants, especially those vulnerable to impacts of development. She recorded those plants that were adventive, or were aliens becoming established and even weedy (several of which would turn out to be first reports for the State), or were escapees from gardens. She described several especially rich and interesting natural habitats and localities, such as areas predominantly of beech and maple forests, or wooded lowlands of Black Ash (*Fraxinus nigra*), Red Maple (*Acer rubrum*) Bur Oak (*Quercus macrocarpa*), Swamp White Oak (*Q. bicolor*), Sycamore (*Platanus occidentalis*), and Black Willow (*Salix nigra*). She noted areas of oak openings near the city and sites with rather large groves of White Pine (*Pinus strobus*), lamenting the widespread cutting of the latter for timber. Specific areas were described floristically, including the Saddle-bag Swamp Region, the Lamberton Lake Region, the Reed's Lake Region, the Crooked Lake (Dean Lake) Region, the Burton Avenue Swamp (dubbed the Orchid Swamp), the Pine Hill white sand bluffs along the Thornapple River, the Mill Creek Woods, the Plainfield Village Bluffs along the Grand River, the Zeeland Swamp stretching from Hudsonville through Zeeland, and Georgetown's Cedar Swamp.

Cole also enumerated species that she viewed as disappearing, those apparently already lost from the flora, and those species that are well-known from the Lake Michigan shores but occur only occasionally in the *Flora* area. She also

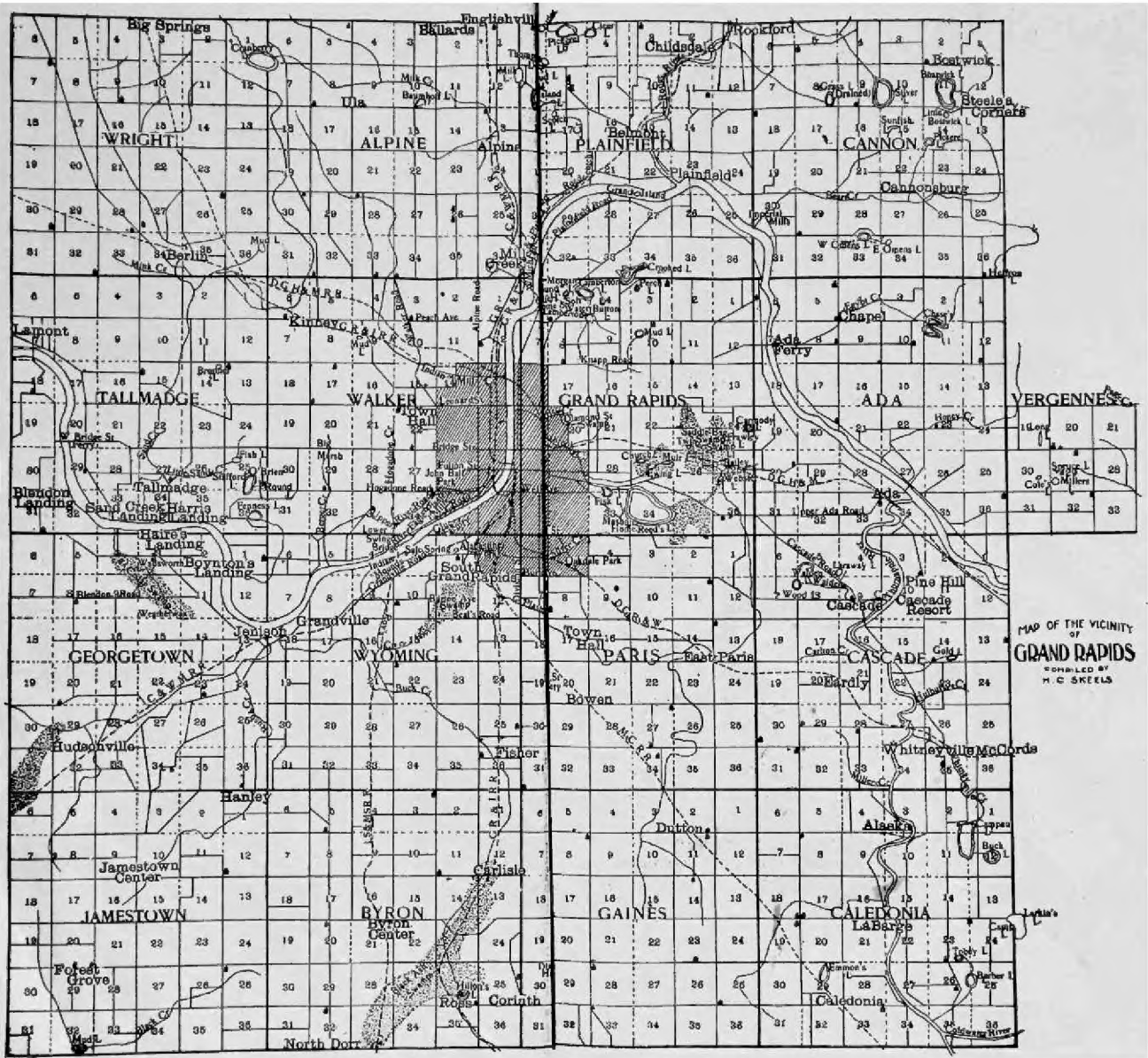


FIGURE 2. The geographical area covered by Cole’s *Grand Rapids Flora* prepared by Homer C. Skeels, a former student of Miss Cole, was included in the front of the *Flora*. The four westernmost townships occur in Ottawa County, all others belong to Kent County; extension eastward of her map includes 9 Sections of Vergennes Township that surround Cole’s family home.

listed those reported in her *Flora* that were then known from nowhere else in Michigan.

Decades after her death, Central High botany teacher Arlene Whittemore (1941) wrote in a loving tribute that Emma spent “six summers in the 1890s [when she] frequently drove a horse and buggy to her collecting areas, especially to her many secret gardens which no one but herself ever saw.”

In addition to teaching botany, serving as the curator of KSI’s herbarium was of enormous value to Emma. Although she began collecting as early as 1873 in the vicinity of her rural family home in Vergennes, no more than 38 of her surviving specimens were collected before 1892. Over 5000 specimens that she and colleagues collected (including more than 2600 collected by Emma herself) can still be found in various herbaria, especially those of the KSI collection housed at the University of Michigan Herbarium (MICH) through a permanent loan agreement in 1974 with the Grand Rapids Public Museum (Voss 1978); addi-

tional specimens are at the Michigan State University Herbarium (MSC), the Albion College Herbarium (ALBC), and other herbaria. The bulk of her specimens were collected between 1890, when she embarked on her project, and 1899, but numerous additional collections were made through 1908 (University of Michigan Museums 2016; Crow unpublished data 2018). A comprehensive updated checklist of all the species covered in Cole's *Flora* and the specimens documenting it is available in Crow (2017).

Emma Cole's exuberance about all things botanical is clearly evidenced by the impact she had on students. Several of them developed a love of botanizing during their high school days and remained keen collectors, contributing significantly to her *Flora* project even beyond their graduation. Particularly noteworthy is a group of students in the class of 1893. These included Homer C. Skeels, Jennie Shaddick, W. Earle Mulliken, Burton E. Livingston, Ralph E. Matteson, Grace Fyfe, and F. P. Daniels. Other Central High alumni who contributed to the *Flora* included S. Owen Livingston and Luther S. Livingston (both brothers to Burton).

A number of Emma's students went on to distinguished careers in science. Homer Skeels and Jennie Shaddick did extensive collecting in 1895 and 1896 for the *Flora* project during the years in which Homer studied botany at Michigan Agricultural College, which provided Emma with much information to describe a very rich woods referred to as Mill Creek Woods (Cole 1901). C. F. Wheeler wrote Emma in 1893 (see Appendix 4, Letter 1) that "Homer Skeels is a good student. We allowed him to enter in advance in botany. He ranked no. 1 in the final Examination." Homer married Jennie and moved on to a position with the US Department of Agriculture in Washington, D.C., in the Office of Foreign Seed and Plant Introduction, and became an expert at seed identification. Burton Livingston also studied botany, receiving a BA from the University of Michigan and a PhD from the University of Chicago; he then conducted research on the physiological ecology of desert plants in Arizona at the Desert Laboratory of the Carnegie Institution of Washington and ultimately obtained a faculty position in plant physiology at Johns Hopkins University (Crow 2017). Ever the mentor, Emma Cole even loaned Earle Mulliken \$100 to enable him to further his studies in the area of ornithology at the University of California at Berkeley, as evidenced by an entry in her will: "cancel note of \$100 held against Earle Mulliken of Berkeley, California, if the same shall remain unpaid at the time he graduates from the University of California" (Cole 1910). She acknowledges in the Introduction to the *Flora* having consulted the collections of Leon J. Cole, a presumed young relative who hailed from New York State and was studying agriculture at Michigan Agricultural College (Cole 1901). Leon became good friends with Earle Mulliken on his visits to Grand Rapids, where they collected plants together. Their passion for natural history is self-evident. The two became co-managing editors of the fledgling *Bulletin of the Michigan Ornithology Club* (Anonymous 1897a, 1898). Leon Cole ultimately received a PhD from Harvard University and became the first chair of the Department of Experimental Breeding (now the Department of Genetics) at the University of Wisconsin-Madison (University of Wisconsin-Madison 2018). For additional biographical information on these individuals, see Crow (2017).

In 1896, Emma Cole played the key role in the establishment of a Grand Rapids Botanical Club in connection with KSI (Botanical Club minutes June–July 1896, University of Michigan Herbarium Archives). This further fostered an interest in the collecting of specimens to contribute to the KSI Herbarium as well as the *Flora* project. Others in the area with a keen interest in natural history began developing private collections that ultimately became part of the KSI Herbarium or herbaria of other institutions; these included specimens of Hattie Bailey (Pieters), the biology and zoology teacher at Central High, of Mary Fallass (from whom Emma rented a room near Central High) and her daughter Florence Fallass, of Charles W. Fallass, Hermann Hyser, and Miss Annah Clark, Miss Mary Clark, and of Central High's principal, Mrs. Hulst (Anonymous 1895, 1896, 1897b; Cole 1901; Crow 2017). C. F. Wheeler, a botanist at Michigan Agricultural College and a coauthor of *Michigan Flora* (Beal and Wheeler 1893), took a great deal of interest in Cole's floristic project and offered to identify or confirm Cole's specimens of difficult groups, especially *Carex* and *Potamogeton* (Cole 1901); extant specimens collected by Wheeler at the Michigan State University Herbarium (MSC) and the University of Michigan Herbarium (MICH) indicate that he came to Grand Rapids to collect sedges (*Carex*) in some of the favored spots himself.

By 1900, Emma Cole was at a stage where her energies were concentrated on writing the manuscript of the *Flora*. Needless to say, production of the manuscript differed considerably from the process today. The earliest manuscripts by the authors were prepared on typewriters—a device hardly known to today's students. However Emma's manuscript predated the ready availability of typewriters and was, of necessity, handwritten. This was especially problematic, as her handwriting was particularly difficult to read (personal experience of both authors). Furthermore, she had to have portions of the manuscript set in lead type by her printer before she could send page-proofs to reviewers for their comments. To facilitate the correct spelling of scientific names for her typesetter she “cut up Mich. Floras [Beal & Wheeler 1893] and pasted the names on cards to aid my printer, as my writing is not legable [sic] at best” (Cole letter to her proof-reader, Luther S. Livingston, March 18, 1900, Appendix 2, Letter 3).

To assure that her scholarly work was of the highest quality, Emma Cole frequently communicated with Dr. Benjamin Lincoln Robinson, Director of the Gray Herbarium, Harvard University, and his (then) young assistant, Merritt Lyndon Fernald, who were in the midst of writing the 7th edition of *Gray's Manual of Botany* (Robinson and Fernald 1908); Fernald was to ultimately produce the highly venerated 8th edition of *Gray's Manual of Botany* (Fernald 1950). Not only did they provide advice and commentary in response to her questions of nomenclature and species identity—Cole (1901) specifically acknowledged Fernald's contribution to her treatment of the notoriously difficult genus of Asteraceae, *Antennaria* (pussytoes)—but Fernald even offered to read the page-proof of the entire manuscript, including the index (Crow 2017). Numerous letters from Emma Cole to both Robinson and Fernald are preserved in the Archives of the Gray Herbarium at Harvard University; these letters open a fascinating window (though only one-way) into the production of Cole's *Flora* (see Appendix 1 for a complete transcription of these letters).

Another person who was key to the completion of her *Flora* was her trusted

proofreader, Luther S. Livingston, an alumnus of Central High, class of 1881, the same year Emma Cole began her teaching career (Anonymous 1896; Stivers 2007; Crow 2017). We speculate that when Luther returned to Grand Rapids to attend a 15-year class reunion, he may have offered to serve as a proofreader when she reached the stage of generating the typeset proof sheets. In a letter written to him on Christmas Eve of 1899, she wrote: “The ‘Flora’ I hope will soon be in the hands of a publisher and I have in kindly remembrance ‘a promise’ that if possible you would assist me in the looking over the proof. Are you too busy to do so? It will come in 16 pages or its equivalent about once in two weeks or so. I shall esteem it a great favor if you can do so as I have never read proof” (Cole letter, Dec. 24, 1899, Appendix 2, Letter 1).

A fascinating piece was published in the 1896 yearbook updating Luther Livingston’s activities during the 15 years since his graduation (undoubtedly submitted by Luther). For a period he was employed by Pitcher & Manda Nurseries in Short Hills, New Jersey, where he was appreciated for his ability to write concise, accurate descriptions for their catalogs. His employers then sent him on an 18-month expedition to Colombia in South America as a collector of orchids, from where he sent back thousands of live plants for sale in their greenhouse operation (Anonymous 1896; Crow 2017). Later he became a highly esteemed rare book dealer in New York City. Luther’s skills as a proofreader came from his extensive experience in preparing detailed rare book catalogs for his company, Dodd & Livingston. For additional biographical information see Crow (2017) and Winship (1914).

Remarkably, letters from Emma Cole to Luther Livingston relating to the production and proofreading of the *Flora* were discovered in the Archives of the Gray Herbarium, Harvard University. Why at Harvard, if he was a book dealer in New York City? It turns out that Luther was so esteemed in the world of rare books that he received and accepted an offer to become the first librarian of the Harry Elkins Widener Memorial Collection in the Harvard College Library at the Widener family’s request. Sadly, he passed away in 1914, within six months after beginning this new career. His wife, Flora Virginia Livingston, was named Assistant Librarian of the Widener Collection following his death and later promoted to Librarian (Social Networks and Archival Context 2017). Because of his life-long passion for botany, those letters to Luther were preserved in the Gray Herbarium Archives. Since they shed considerable light on the production phase of Emma Cole’s *Flora*, we have transcribed and included here her letters to her valued proofreader (see Appendix 2). Also included is the single surviving mis-sive from Luther to Emma Cole (Livingston’s notes, June 1900, referred to in Cole’s letter back to Luther Livingston dated June 15, 1900, Appendix 2, following Letter 7). Evidently, the process of proofing prompted a number of botanical memories from his youth, and he made notes on several plants and on those specific recollections; several of these comments were incorporated by Emma into her *Flora*. A sample from his notes regarding the orchid *Arethusa bulbosa* (Arethusa) along with information squeezed into Cole’s text subsequent to the typeset proof sheet are reproduced in Table 1. While Luther remembered gathering flowers of *Arethusa* every spring, this species has unfortunately not been documented in Kent County since 1896 (MICHIGAN FLORA ONLINE 2011).

TABLE 1. Luther Livingston’s notes and Cole’s incorporation of the information from them into the *Grand Rapids Flora*.

Luther Livingston’s Notes (Gray Herbarium Archives)	Emma Cole’s <i>Grand Rapids Flora</i> (Cole 1901, page 47)
ARETHUSA L.	
402 [400]. A[rethusa] bulbosa [Arethusa] The first I saw were gathered by my brother Lincoln in the spring of 1882 or 1883. We gathered them every spring as long as I was in G. R. They grew in the soft mounds or cushions of living sphagnum, never were very abundant but, I presume we have gathered 30 flowers in a season. I think “In sphagnum in Orchid S.” would be better than in bogs because they did not grow in really boggy places as did the Calopogon, for instance. [Emma took his advice.]	400. A. bulbosa L. In the sphagnum of Orchid Swamp; rare. Mid May–Mid-June. L. S. Livingston and Prof. R. H. Wolcott report this species as having been rather abundant in this swamp in the eighties. In 1898 seven plants were found (O.H.) [O.H. = Our Herbarium, collections of Homer Skeels & Jennie Shaddick; Orchid Swamp now extinct].

In fact, the incredibly interesting “Orchid Swamp” has been lost to growth and development of Grand Rapids. Also referred to as Burton Avenue Swamp (Figure 2, Wyoming Twp. Sec. 2), this site once occupied a large area southwest of the 1900 City boundary and was famous for a number of rare, acid-loving plants, especially orchids.

Having sent Luther Livingston a copy of her newly printed *Flora*, Emma Cole informed him of the costs of producing this work—which came out of her own pocket (Table 2), (Cole letter, Apr. 10, 190[1], Appendix 2, Letter 16).

TABLE 2. Statistics relating to the production of the *Flora*, including the costs to Emma Cole of carrying out the *Flora* project (Emma Cole unpublished letter to Luther Livingston, April 10, 190[1], Gray Herbarium Archives, Harvard University). The 2018 values in parentheses are from Official Data Foundation (2018).

Item	Expense or other data
Printing and map insert	\$226.00 (\$6,749.26)
Expenses for summer fieldwork	\$324.00 (\$9,675.94)
Price per book	\$1.00 (\$29.86)
Number of copies printed	1000
Market	Public libraries, private libraries, Cole’s pupils, reference in the surrounding counties
Estimated supply	Approx. 50 years

LIFE AFTER THE *FLORA*

The Spring of 1901 brought the publication of *Grand Rapids Flora: A Catalogue of the Flowering Plants and Ferns Growing Without Cultivation in the*

Vicinity of Grand Rapids Michigan (Cole 1901). With such an all-consuming project having come to an end, Emma now had time to give greater attention to a difficult group of plants that had fascinated and perplexed her during her *Flora* project, the genus *Crataegus* (Rosaceae). That same year she received her first visit from Charles Sprague Sargent, Director of the Arnold Arboretum at Harvard University. Sargent was the outstanding authority of his time on North American trees, and he produced numerous publications on woody plants, including *The Silva of North America* (14 volumes, Sargent 1890–1902) and *The Manual of the Trees of North America* (Sargent 1905), both still standard references.

Among Sargent's many passions was the genus *Crataegus*, or what we know as the hawthorn or thornapple. Voss (1985) wrote in *Michigan Flora*, "*Crataegus* is a genus easy to recognize, but the species (or other taxa) of which drive most botanists to distraction. Hybridization, polyploidy, and apomixis presumably account for much of this complexity, asexual populations breeding true and acting as species but better thought of as individuals." Voss further noted that, prior to 1900, regional floras included only a handful of species, but between 1900 and 1925, more than 1000 supposedly distinct new species of *Crataegus* were described (most based on trivial characters), more than 700 of these by C. S. Sargent. Among these were species included in his treatment of *Crataegus* in southern Michigan (Sargent 1907).

The details of the taxonomic debate surrounding this genus as to which of these species are truly distinct has created a nomenclatural labyrinth. Suffice it to say that, according to Voss (1985), Michigan "was one of the active sites in the early 'expansionist' days of hawthorn study." Emma Cole sent a large amount of material to Sargent. As a result of Sargent's visit to Grand Rapids in September 1901, as well as of her research in collecting both flowering and fruiting specimens from the same trees, Sargent (1902b) credited her help in describing twenty new species, and even named one *Crataegus coleae*, a recognition that has persisted despite disputes between "lumpers" and "splitters." Fernald (1950) stated in *Gray's Manual of Botany* that *Crataegus coleae* was "named in 1902 for its discoverer, Emma J. Cole," and Voss and Reznicek (2012) retained its status as a distinct species in *Field Manual of Michigan Flora*.

Emma Cole (1902) wrote a newspaper article about another hawthorn for *The Evening Press* on June 21, 1902, chronicling Sargent's visit to the city the previous autumn and his discovery of another species, *Crataegus gemmosa*, based on a tree located on the north side of the city. In her article "Grand Rapids Owns a Famous Thorn Tree," she wrote: "The [specimen] for the drawing was taken from this tree; this makes it a type plant" (to which the scientific name is nomenclaturally attached) in Sargent's (1890–1902) *Silva of North America*. The species was described by Sargent (1902b) based on specimens known from Ontario (near Toronto and near London), New York (Rochester), and Michigan (Belle Isle and Grand Rapids); the collection from Grand Rapids (*Miss E. J. Cole and C. S. Sargent*, s.n. (A), September 1901) was among those cited as a type specimen.

Emma Cole and Charles Sargent corresponded for the rest of her life. Emma spent the summer of 1904 working with Sargent at the Arnold Arboretum in Jamaica Plain, Massachusetts (Anonymous 1906; Barkley 1911). During that time,

she collected about 75 specimens in Jamaica Plain and in Cambridge between June 25 and August 20 (University of Michigan Museums 2016). Sargent returned to Michigan for another visit in 1907, as referenced in the typewritten copies of some of the 15 letters he sent to her that are preserved in the Harvard University Arnold Arboretum Horticultural Library archive (Correspondence of C. S. Sargent) (reproduced here in Appendix 3). Unfortunately her letters to him are not in that archive.

Once she was freed from the demands of documenting the flora of the Grand Rapids area, Emma indulged in some traveling. The most valuable record of her travels is her herbarium. Wherever she went she collected, preserved, and labeled plant specimens that provide a chart of her progress through the years and across the continents. It is from her herbarium specimens that we know that she was in Europe from early July to mid-October 1903. This was no “package tour!” In fact, we can trace her travels as she collected plants in Wales, England (near border with Wales), Ireland (in the area now constituting Northern Ireland), Scotland, England (London area), France (Paris area), The Netherlands, Germany, Switzerland, Italy, and the French Mediterranean coast. In a letter to B. L. Robinson in 1904 asking about published floras for areas in Europe, she mentions her desire “...to identify my collection as far as possible myself. I have about four-hundred specimens in all. One hundred sixty from the British Isles which I have just been going through” (Cole letter, Jan. 21, 1904, Appendix 1, Letter 27). A total of 221 specimens from these travels are known to be extant at the University of Michigan Herbarium (University of Michigan Museums 2016) (Table 3); the whereabouts of the others is unknown.

Before she left for Europe, Emma made out a Last Will and Testament (Cole 1910) in which she established several significant bequests. Among these bequests was a modest trust for the Board of Education of Grand Rapids for the support of the Botany Laboratory at Central High. To the Kent Scientific Institute she willed her personal herbarium, along with her microscope, prepared

TABLE 3. Numbers of specimens collected by Emma Cole during her travel to Europe in 1903, based on data in the University of Michigan Herbarium Specimen Database (University of Michigan Museums (2016).

Date of Collections	Geographical Location	Number of Specimens
July 3	Wales	32
July 4	England (near border with Wales)	3
July 8	Ireland (Dublin)	1
July 9	Ireland (Belfast area)	20
July 13–21	Scotland (Stirling/Abbotsford etc.)	35
July 24–Aug 6	England	8
Aug 14–18	France (Ile-de-France)	17
Aug 23	The Netherlands	3
Aug 30	Germany (Thuringia area)	24
Sept 8–9	Switzerland (Lake Lucerne area/Bern/Geneva)	51
Sept 27–Oct 6	Italy (Rome/Naples)	20
Oct 10	France (French Alps/Nice)	7
TOTAL		221

slides and lantern slides, 300 copies of *Grand Rapids Flora*, and future revenue from the sales of the *Flora*. According to the KSI Annual Report of 1912, the collection numbered 3,581 completed pages, plus 1,278 pressed specimens waiting to be mounted (Grand Rapids Public Museum 1912).

There is evidence that she spent July and August of 1905 in the American West, where she visited her former student, Earle Mulliken, and did botanical work at the University of California at Berkeley (Anonymous 1906). This trip is also substantiated by specimens collected in southern California (11 specimens), Alberta (Banff National Park, 15 specimens), British Columbia (Glacier National Park, 23 specimens), Seattle, Washington, (5 specimens), as well as a stop at the little town of Bottineau, North Dakota, to visit her brother John (65 specimens) (University of Michigan Museums 2016).

Sometime after her western US trip in 1905, Emma began to have health problems. In 1906, Sargent made reference to her health (Sargent letter, 23 Aug. 1906, Appendix 3, Letter 2), and his January 30, 1907 letter (Appendix 3, Letter 5) was addressed to her at The Park [Hotel] in St. Louis, Michigan, a well-known hotel spa famed for its magnetic mineral springs and often called the “Saratoga of the West” (see also Sargent letter, Aug. 31, 1907, Appendix 3 Letter 11, referring to his letter of Aug. 16th, letter 10, that also had been addressed to the spa in St. Louis, Michigan, but had apparently not been received by Cole). Prompted by continuing health issues, she added a codicil to her will in November 1907, that among other things, provided a trust for the care of her brother Hugh. Apparently there had been some bad feeling between the two, which was expressed quite vehemently in her original will.

Emma retired from teaching at Central High School in May 1907. That September Professor Sargent returned for another visit and more hawthorn botanizing, and he wrote to her after he returned to Harvard that he was delighted that she “got no cold in those two stormy days” (Sargent letter, October 29, 1907, Appendix 3, Letter 14). When their work on Michigan hawthorns was largely finished, she sent him all her duplicate specimens of *Crataegus* in June 1908, along with all her notes on them (see Appendix 3, Letter 15, acknowledging receipt, and Letter 16, dated June 16, 1908, with Sargent’s detailed comments on the specimens and notes). At least 20 species of hawthorns described by Sargent as new to science were based on Michigan collections of Emma Cole (see Appendix 3, Letter 6).

In October 1907, Emma wrote to Mary Ann Day, librarian of the Harvard University Gray Herbarium Library at Cambridge. She told Miss Day of her upcoming trip to Cuba and asked if she knew of an English translation of a guide to the flora of the West Indies. If there was only a Spanish-language edition available, she continued, would it be better to buy it beforehand or wait and buy it in Havana (Cole letter to Miss Day dated Dec. 24, 1899, Gray Herbarium Archives)? She did manage to botanize on that trip, but her collections are few (35 specimens, MICH), with labels dated between mid-February and mid-April 1908. Emma was in Michigan for the summer of 1908, according to continuing correspondence with C. S. Sargent, but she escaped during the winter of 1909 to California, according to her friend Orinda Barkley (1911).

In January 1910, Emma went to Mexico on a plant collecting trip. She fell ill

in April on her return journey. When she reached San Antonio, Texas, she was hospitalized and died shortly thereafter (Barkley 1911). According again to Miss Barkley her illness was pronounced “walking typhoid,” but her death certificate, dated April 25, 1910, says that the cause of death was acute nephritis, that is, kidney failure.

Emma Cole’s death was widely reported in the Grand Rapids (Anonymous 1910a, c) and Lowell newspapers (Anonymous 1910b, d). That she was an active and well-known personality was apparent not only from the obituaries, but also by public tributes such as high school teacher W. A. Greeson’s (1910) memorial of Miss Cole, and Orinda Barkley’s (1910) tribute before the Ladies Literary Club, where Emma was a long-time member and frequent presenter, and by her fellow Michigan educators.

Emma left behind a very substantial estate (Cole 1910), totaling \$27,562.27 (\$734,928.24 in 2018 dollars, based on the inflation calculator at Official Data Foundation 2018). She left cash bequests to two dozen personal friends, to her brothers, a niece and nephews. She also left an unusual endowment of \$5,000 to nine downtown area churches to fund an annual “flower service” to be held on the second Sunday of June, the sermon to be focused on flowers and the churches to be amply decorated with floral arrangements, with the object of perpetuating the love of and interest in flowers. Eight of those nine churches carried out this request, holding services each year, an activity that continued through 1967, as documented in large ledgers at the Grand Rapids Public Library. An appreciation of Emma Cole was published regularly in the bulletins accompanying the flower services, written by Charles W. Garfield (1934), who was in 1865 a founding member of the Grand Rapids Scientific Club, one of the two original organizations that became the basis for the Kent Scientific Institute (Stivers 2004). In his tribute, Garfield (1934) wrote, “Miss Cole saw the ruthless destruction of the beauty given us in the wealth of Nature’s productions” and “[she] felt that there was a spiritual significance connected with the responsibility of mankind to maintain the delicately beautiful things”

Perhaps the most interesting gift in Cole’s will was an endowment to the Regents of the University of Michigan establishing the Emma J. Cole Fellowship, which persists to this day, a fellowship in Botany for a graduate student who “has given evidence of distinguished attainments.” Dr. Edward G. Voss was a recipient during his doctoral program, and Dr. David P. Warners, our colleague on the present Emma Cole flora project, received the Cole Fellowship during his doctoral program. The payout to the University of Michigan was an impressive \$14,611.36 (\$389,601.48 in 2018 dollars).

After Emma’s death, F. C. Newcombe, professor of Botany (Barkley 1911) at the University of Michigan, wrote to her friend Orinda Barkley requesting biographical material to use in conjunction with the Cole Fellowship. She sent him a tribute she had presented before the Ladies Literary Club on May 20, 1910. In a note, she added some more personal information. She wrote that Emma was buried in the Vergennes Township cemetery near the church she had attended when a girl and that “[f]rom her grave can be seen her early home, the school house in which she first taught, —the woods where she first gathered the flowers she studied.” It’s very easy to find her grave, adjacent to the little Methodist

church at the corner of Bailey Drive NE and Parnell Avenue NE between the town of Ada and city of Lowell, marked by a large stone which Emma herself had selected years before.

Over 100 years ago, Emma Cole dedicated herself to researching the natural biodiversity of West Michigan and creating a record of it. Even then she expressed great concern about what was being lost. In the Introduction to the *Flora*, Cole wrote:

Since the district has become more thickly settled, it is undergoing rapid transformation. Much of the swamp land is being drained, cleared, and utilized; forests are being deprived of their valuable timber, and uplands converted into farms. The woodlands at present consist mostly of the ‘wood-lot’ reserved by the farmer.

With understated and perhaps unintended irony, she concluded, “From the standpoint of systematic botany, this district is unfortunate in having *so little* territory which is not capable of cultivation” [italics added].

At the end of Emma Cole’s newspaper article about the hawthorn tree she and Charles Sargent found in Grand Rapids (Cole 1902), she wrote, “It is with this beautiful tree as with many noble people—honor comes tardily yet deservedly to crown the best part of life—that enriched by experience.” Emma’s life was richly crowned by experience, unusually so for a woman of her time. By her passion and her pursuit of a professional vocation in science during a time when it was very difficult for women to do so, she inspired, and continues to inspire, botanists both amateur and professional, who love the natural world and wish to preserve it. In 1994, she was remembered in the celebration of Women’s History Month in Grand Rapids in a play about several of the city’s significant women (Bahle 1994), and in 2000, Emma’s work was highlighted in an exhibition at the Frederik Meijer Gardens & Sculpture Park in Grand Rapids, also as part of Women’s History Month. Her induction into the Michigan Women’s Hall of Fame in 2007 continued the recognition of her life’s work and her contributions to both science and education. And her *Grand Rapids Flora* continues to provide a critical historical context and inspiration for us to know Grand Rapids’ flora in the twenty-first century.

ACKNOWLEDGMENTS

We wish to express our appreciation to the Grand Rapids Public Museum for access to information on the Kent Scientific Institute in the Community Archives and Research Center, and to the Grand Rapids Public Library for access to the Emma Cole files in the Grand Rapids History & Special Collections, Archives. The Harvard University Herbaria - Botanical Libraries (Gray Herbarium archives) kindly provided access to letters handwritten by Emma J. Cole to botanists Benjamin Lincoln Robinson and Merritt Lyndon Fernald, as well as letters to her proofreader Luther Samuel Livingston. The Arnold Arboretum of Harvard University Horticultural Library Reference Services provided photocopies of letters from Charles Sprague Sargent to Emma Cole. The University of Michigan Herbarium Archives provided the letters from Charles Faye Wheeler to Emma Cole. We are grateful to the University of Michigan Herbarium for access to Emma Cole’s specimens as well as specimen data of colleagues and students relating to the *Flora* project from the late-1800s; the late Dr. Edward G. Voss, Dr. A. A. (Tony) Reznicek and Beverly Walters were especially helpful at various stages of our project. The Michigan State University Herbarium likewise provided access to specimens and specimen data documenting Cole’s work. We would like to express our appreciation

to Megan Crow and anonymous reviewers for reading and suggesting changes to improve the manuscript.

LITERATURE CITED

- Anonymous. (1877). Notice in newspaper. Lowell Journal Volume XIII, Number 16 (October 17). Lowell, Michigan.
- Anonymous. (1891). Kent Scientific Institute Proceedings of the Board of Directors. Volume 1 (November 6, 1891). The Public Museum of Grand Rapids Archives, Grand Rapids, Michigan.
- Anonymous. (1892). Kent Scientific Institute Proceedings of the Board of Directors. Volume 1 (June 3, 1892). The Public Museum of Grand Rapids Archives, Grand Rapids, Michigan.
- Anonymous. (1895). Yearbook. Central High School. Grand Rapids History & Special Collections, Archives, Grand Rapids Public Library, Grand Rapids, Michigan.
- Anonymous. (1896). Delphian. Yearbook of Central High School. Grand Rapids History & Special Collections, Archives, Grand Rapids Public Library, Grand Rapids, Michigan.
- Anonymous. (1897a). [Masthead]. Bulletin of the Michigan Ornithology Club 1:7.
- Anonymous. (1897b). Tabularium. Yearbook of Central High School. Grand Rapids History & Special Collections, Archives, Grand Rapids Public Library, Grand Rapids, Michigan.
- Anonymous. (1898). [Masthead]. Bulletin of the Michigan Ornithology Club 2:9. Available at <https://www.biodiversitylibrary.org/item/127766#page/15/mode/1up>.
- Anonymous. (1906). Notice in newspaper. Grand Rapids Herald, June 14, 1906. Grand Rapids.
- Anonymous. (1910a). Obituary. Grand Rapids Herald, April 26, 1910. Grand Rapids, Michigan.
- Anonymous. (1910b). Lowell Teacher. Lowell Michigan Ledger, Volume XVII, Number 45 (April 28, 1910). Lowell, Michigan.
- Anonymous. (1910c). Funeral arrangements. Grand Rapids Herald, May 3, 1910. Grand Rapids, Michigan.
- Anonymous. (1910d). Old Teacher Rests [Obituary]. Lowell Michigan Ledger, Volume XVII, Number 46 (May 5, 1910). Lowell, Michigan.
- Bahle, J. R. (1994). Invisible Journeys. Unpublished play. Archives, Greater Grand Rapids Women's History Council, Grand Rapids, Michigan.
- Barkley, M. O. (1910). Testimonial—Miss Emma J. Cole. Ladies Literary Club, Grand Rapids, May 20, 1910. Grand Rapids, Michigan.
- Barkley, M. O. (1911). Correspondence between Miss M. O. Barkley, Grand Rapids, and Mr. F. C. Newcombe, Ann Arbor, Michigan. Bentley Historical Library, University of Michigan, Ann Arbor, Michigan.
- Baxter, A. (1891). History of the City of Grand Rapids, Michigan. Munsell & Co., New York, N.Y., and Grand Rapids, Michigan.
- Beal, W. J. and C. F. Wheeler. (1893). Michigan flora. Report of the State Board of Agriculture, Michigan 30: 471–650. [Reprinted and repaginated 1–180].
- Beers, J. H. (1900). Educators of Michigan. Biographical. J. H. Beers & Co., Chicago, Illinois.
- Bishop, M. (1962). A history of Cornell. Cornell University Press, Ithaca, N.Y. Available online at: https://books.google.com/books?id=jUu9pDRhWjkC&printsec=frontcover&source=gbs_atb#v=onepage&q&f=false.
- Britton, N. L., and A. Brown. (1896–1898). Illustrated flora of the northern United States. 3 volumes. Charles Scribner's & Sons, New York, N.Y.
- Chapman, C. C., editor. (1881). Chapman's illustrated history of Kent Co., Michigan. Chas. C. Chapman & Co., Chicago, Illinois.
- Cole, E. J. (1898). Cleistogamous flowers on *Solea Concolor*. Asa Gray Bulletin 6: 50.
- Cole, E. J. (1901). Grand Rapids flora: A catalogue of the flowering plants and ferns growing without cultivation in the vicinity of Grand Rapids, Michigan. Privately published. Available online at: <https://archive.org/stream/grandrapidsflora00cole#page/n5/mode/2up>.
- Cole, E. J. (1902). Grand Rapids owns a famous thorn tree. The Evening Press [Grand Rapids Press], April 21, 1902, p. 8. Grand Rapids, Michigan.
- Cole, E. J. (1910). Last will and testament. Will signed June 10, 1903; Codicil 1 signed November 14, 1907; Codicil 2 signed November 9, 1909. Will and probate documents (1910) examined and copied March 15, 2007 by Julie Stivers at Kent County Probate Court, Grand Rapids, Michigan.

- Cole, E. J. (1962). Green dragon (*Arisaema dracontium*). *The Michigan Botanist* 1: 56–59.
- Coleman, N. (1874). Catalogue of flowering plants of the southern peninsula of Michigan, with a few of the Cryptogamia. Kent Scientific Institute, Grand Rapids, Michigan.
- Cornell University. (1993). Unpublished letter from Nancy Dean, Special Collections, to Linda Sweigart, Public Museum of Grand Rapids, with attached typescript copy of courses and grades of Emma J. Cole 1876–1877, 1879–1880. Rare and Manuscript Collections, University Library, Cornell University, Ithaca, New York.
- Crow, G. E. (2017). Emma Cole's 1901 Grand Rapids flora: Nomenclaturally updated and revised. *The Great Lakes Botanist* 56: 98–176.
- Fernald, M. L. (1950). Gray's manual of botany, 8th edition. American Book Co., New York, N.Y.
- Garfield, C. W. (1934). The spirit of Flower Sunday. *The Central Christian*. Volume IV, No. 24. June 22, 1934. Central Christian Church of Christ, Grand Rapids, Michigan.
- Goss, D. (1906). History of Grand Rapids and its industries. Volume 2. C. F. Cooper & Co., Chicago, Illinois.
- Grand Rapids Public Museum. (1912). Annual report of 1912. Kent Scientific Institute records, Community Archives & Research Center, Grand Rapids Public Museum, Grand Rapids, Michigan.
- Gray, A. (1888). Synoptical flora of North America: The Gamopetalae. I, pt. II, and II, pt. I, second edition. Smithsonian Institution, Washington, D.C.
- Gray, A., L. H. Bailey, S. Watson, and J. M. Coulter. (1890). Manual of the botany of the northern United States, including the district east of the Mississippi and north of North Carolina and Tennessee, arranged according to the natural system (6th edition). American Book Company, New York, N.Y.
- Greeson, W. A. (1910). To the memory of the following teachers of the Grand Rapids, Michigan Central High School, 1907–1911, Miss Annah M. Clark, Miss Emma J. Cole, Miss Catherine MacArthur, Mr. A. J. Volland, Miss Ellen Dean, Mr. A. J. Daniels. Report of papers read in Lecture Room, Park Congregational Church, November 12, 1910. Grand Rapids History & Special Collections, Archives, Grand Rapids Public Library, Grand Rapids, Michigan.
- Hewett, W. T. (1905). Cornell University, a history. Volume 1. The University Publishing Society, New York, New York.
- Hooker, J. D. (1884). The student's flora of the British Islands (third edition). Macmillan & Co., London, U.K.
- Jackson, B. D. (1893). Index Kewensis plantarum phanerogamarum. 2 Vols. Clarendon Press, Oxford. Now incorporated into the online International Plant Names Index, <http://www.ipni.org/index.html>.
- Lammers, T. G. (2016). Nathan Coleman, Michigan's mystery botanist. *The Michigan Botanist* 55: 74–88.
- MICHIGAN FLORA ONLINE. (2011). Reznicek, A. A., E. G. Voss, and B. S. Walters. University of Michigan. Available at <http://michiganflora.net/home.aspx>. (Accessed September 22, 2014 and numerous times following).
- Michigan Natural Features Inventory. (2016). Michigan's special plants. Available at <http://mnfi.anr.msu.edu/data/specialplants.cfm>. (Accessed October 31, 2016).
- Michigan Women's Hall of Fame. (2007). Emma Cole (1845–1910). Available at http://www.michiganwomenshalloffame.org/Inductee_PDFs%20New/Cole_Emma.pdf. (Accessed September 3, 2018).
- Official Data Foundation. (2018). CPI inflation calculator. Available at <http://www.in2013dollars.com/1901-dollars-in-2017>. (Accessed 6 August 2018).
- Robinson, B. L. 1901. Review: Grand Rapids flora; by Emma J. Cole. *American Journal Science Ser.* 4: 472–473.
- Robinson, B. L., and M. L. Fernald. (1908). Gray's new manual of botany, 7th edition, illustrated. A handbook of the flowering plants and ferns of the central and northeastern United States and adjacent Canada. American Book Company, New York, N.Y.
- Sargent, C. S. (1890–1902). The silva of North America: A description of the trees which grow naturally in North America exclusive of Mexico. Houghton Mifflin & Company, Boston, Massachusetts and New York, N.Y.
- Sargent, C. S. (1902a). *Crataegus coleae* Sarg. P. 7 in *Trees and shrubs: Illustrations of new or little*

- known ligneous plants. Vol. 1 (Part 1). Arnold Arboretum of Harvard University, Boston, Massachusetts.
- Sargent, C. S. (1902b). New or little known North American trees. IV. Botanical Gazette 33: 108–125. [*Crataegus gemmosa*, pp. 119–121]
- Sargent, C. S. (1905). Manuals of trees of North America (exclusive of Mexico). Houghton Mifflin, Boston, Massachusetts.
- Sargent, C. S. (1907). *Crataegus* in southern Michigan. Pp. 515–565 in State Geological Survey Report, Michigan 1906. State Board of Geological Survey, Lansing, Michigan.
- Social Networks and Archival Context. (2017). Livingston, Flora Virginia Milner, 1862–. Available at <http://socialarchive.iath.virginia.edu/ark:/99166/w6qj7n8z> (Accessed December 9, 2017).
- Stivers, J. C. (2004). The presence of the past: The Public Museum of Grand Rapids at 150. The Public Museum of Grand Rapids, Grand Rapids, Michigan.
- Stivers, J. (2007). Emma Cole (1845–1910). Greater Grand Rapids Women’s History Council, Newsletter Fall 2007, pp. 3, 8. Issue also available online at https://www.ggrwhc.org/wp-content/uploads/2017/11/Newsletter_for_the_web.pdf.
- Tropicos. (2018). Tropicos.org. Missouri Botanical Garden. Available at <http://www.tropicos.org>. (Accessed January 8, 2018).
- University of Michigan Museums. (2016). Herbarium collections of Emma Cole and the Grand Rapids Public Museum at the University of Michigan Herbarium. <http://nsf-biomuseums.eeb.lsa.umich.edu/drupal/?q=emma-cole> (Accessed September 4, 2018).
- University of Wisconsin-Madison. (2018). Genetics: History. Available at <https://genetics.wisc.edu/history/> (Accessed August 18, 2018).
- Voss, E. G. (1972). Michigan flora. Part I: Gymnosperms and monocots. Cranbrook Institute of Science and University of Michigan Herbarium, Ann Arbor, Michigan.
- Voss, E. G. (1978). Botanical beachcombers and explorers: Pioneers of the 19th Century in the Upper Great Lakes. Contributions from the University of Michigan Herbarium 13: i–viii, 1–100.
- Voss, E. G. (1985). Michigan flora. Part II: Dicots (Saururaceae–Cornaceae). Cranbrook Institute of Science and University of Michigan Herbarium, Ann Arbor, Michigan.
- Voss, E. G. (1996). Michigan flora. Part III: Dicots (Pyrolaceae–Compositae). Cranbrook Institute of Science and University of Michigan Herbarium, Ann Arbor Michigan.
- Voss, E. G., and A. A. Reznicek. (2012). Field manual of Michigan flora. University of Michigan Press, Ann Arbor.
- Whittemore, A. (1941). Emma J. Cole, founder of a fellowship in botany. Unpublished article. Archives of the Greater Grand Rapids Women’s History Council, Grand Rapids, Michigan.
- Winship, G. P. (1914). Luther S. Livingston: a biographical sketch. The Papers of the Bibliographical Society of America 8: 109–120. (Article also available online at https://en.wikisource.org/wiki/Luther_S._Livingston,_1864%E2%80%931914).

APPENDICES

These appendices reproduce the text of the letters chosen for inclusion. All header and other ancillary information other than the city and the date is omitted. No attempt has been made to reproduce the format of the date or the placement on the page of such items as the header, the signature, or other similar items. Editorial comments by the authors inserted in the bodies of the letters are enclosed in square brackets.

APPENDIX 1. Letters from Emma Cole to Dr. Benjamin Lincoln Robinson (1864–1935) and Merritt Lyndon Fernald (1873–1950), Gray Herbarium of Harvard University. Handwritten letters in Gray Herbarium Archives, Harvard University Herbaria Botanical Libraries (photocopies obtained by Julie Stivers on March 13, 2007 and transcribed by Garrett Crow and Julie Stivers).



FIGURE 3. Dr. Benjamin Lincoln Robinson, Director, Gray Herbarium, Harvard University (Photo ca. 1900; source: Botany Libraries photograph collection, Harvard University).



FIGURE 4. Merritt Lyndon Fernald, Assistant, Gray Herbarium, Harvard University (Photo 1904; source: James Franklin Collins papers, Botany Libraries photograph collection, Harvard University).

LETTER 1

Grand Rapids, October 20, 1898

Dr. Robinson,

Do you intend to revise Gray's Manual and follow the new arrangement of orders [families] and the nomenclature of the "Synoptical Flora" [Gray 1888]? We use the Lessons & Manual in our High Schools. I am ready to make out a list of plants of this locality and the question of nomenclature and arrangement of families trouble me. What would you advise me to do? If you can give me any assistance in this matter of discussion I shall be greatly obliged to you.

Yours Respectfully,
Emma J. Cole

LETTER 2

Grand Rapids, October 30, 1898

Dr. Robinson

Dear Sir.

Yours of the 25th is at hand and I have been thinking seriously over its contents and have made up my mind to follow your advice. [I]t is better to be sure of the plants than to be too particular about nomenclature and they have all been named with Gray. Prof. C. F.

Wheeler has from time to time gone through the herbariums of the City and has identified the sedges and all other doubtful plants and the "List" when published ought to represent this district thoroughly and accurately. I think I shall get my "List" ready for publication this winter, writing each species on a separate card, and when the "School Manual" has been revised, go through and make the changes which are not yet published in the Synoptical Flora [Gray 1888]. Then my "List" will be in agreement with the "School Manual" and also with the "Synoptical Flora", as I now understand it. If the "Manual" is published within the coming year, this will not delay me very much and I shall have another season. I am trying to cover twelve miles in any direction from a central point in the City; and we have now nearly twelve hundred plants. It is a very rich district as the Northern and Southern State floras overlap in the Grand River Valley. If you will be kind enough to let me know if my plans can be carried out regarding the "Manual" I shall begin my manuscript at once.

Yours truly,
Emma J. Cole

LETTER 3

Grand Rapids, [no date, but seems to fit after the October 30, 1898 letter to Robinson]
Dr. B. L. Robinson.
Dear Sir.

In thinking over my manuscript, I have decided to send you my list of plants which will be placed in the Introduction of my Flora. I shall have them put in, in double columns alphabetically without authority or common name, just as I have noticed lists in the Government publications. If these are correct, it will make it much easier for my publisher because a change in nomenclature changes its place in the "list." So I have thought best to send the manuscript lists instead of waiting for the proof as I at first thought. The proof of the main part of the book can be changed with little trouble. The manuscript as I send it, is a rough copy of that which I retain, so scratch it up or correct it as it needs. You need give no attention to the spelling, just see if I have revised as I should have done. Prof. C. F. Wheeler has assisted me on the sedges, still you may see changes that he has omitted, there are few sedges in the lists I send you. The northern v Southern Plants overlap in the Grand River Valley and I have tried to show this by my lists. I have also tried to give a picture of the lesser flora in our "oak openings." I am not certain how I should service *Physalis lanceolata* Michx. Whenever the authority of the species differs from Gray's Manual 6th Edition I have added it for you. I hope I am not troubling you too much. but I feel that you are doing me a great favor in looking after the nomenclature. Prof. C. F. Wheeler has been very kind, but he is in delicate health every winter and scarcely car...[carries?] his own duties. So my manuscript has had no thorough looking through.

Yours Sincerely,
Emma J. Cole

LETTER 4

Grand Rapids, December 2, 1899
Dr. Robinson
Dear Sir

I wrote to you last year about the nomenclature in my "local list of plants." I have made it out according to the Kew Index [Index Kewensis, Jackson 1893], putting in parenthesis the names in the 6th Edition of Gray, when they differed materially. Some of the

plants given as varieties I have made species, as some of the genus *Crataegus*. Is there any way that I could obtain the changes you are making in the edition now in progress? My list I expect to have published this winter.

Yours sincerely,
Emma J. Cole

LETTER 5

Grand Rapids, December 10, 1899
Dr. B. L. Robinson
Dear Sir.

Your kind offer to examine my manuscript or proof is very gracious. I have the manuscript written in cards, one card to a plant. It would be much easier for you to run through one of the first proofs and see if I have omitted what I should have added. I hope this will not inconvenience you with your many duties. I shall not get it in the hands of the publisher till after holidays.

Yours sincerely,
Emma J. Cole

LETTER 6

Grand Rapids, February 23, 1900
Dr. B. L. Robinson.
Dear Sir.

Inclosed [sic] you will find proof for the first pages of the "Grand Rapids Flora". The nomenclature in the main is the Kew Index [Index Kewensis, Jackson 1893]. The names in parenthesis are those of the Gray [Gray et al. 1890], the italics are the Britton [Britton and Brown 1896–1898], when these changes are simply a gender ending I have not added them. I hope you will feel free to make such suggestions or corrections you think should be made. I am having the Catalogue part printed first, as the preface will be a easy matter for the printer.

Be so kind as to return the proof at your earliest convenience.

Sincerely yours.
Emma J. Cole

LETTER 7

Grand Rapids,
March 7, 1900
Dr. B. L. Robinson –
Dear Sir:

I do not wish to occupy too much of your time but there are a few points upon which I am not clear.

1st. In printing *Aleopecurus geniculatus aristulatus* Torr. would you advise that I print it *A. geniculatus aristulatus* in small capitals or only the *aristulatus*?

The same question arises regarding *Phalaris arundinacea picta*, which grows in all of our marshes and I have included it as an introduced plant. I have intended to put introduced plants in small capitals as in Gray.

2^d. Shall I write *Cyperus aristatus* Rottb. or *C. inflexus* Muhl.? How do you intend to have it in the revision of the Flora?

I thank you for your advice and assistance and regret that as my manuscript is in the hands of the printer, I shall not be able to make many changes. Then too I am very busy with school work for I have 110 pupils in my classes in Botany to meet daily. My printer is busy for a few days with this work and I think I may be able to hear from you before my gallie [sic] sheets go into book form.

Sincerely yours,
Emma J. Cole

LETTER 8

Grand Rapids,
April 10, 1900
Dr. B. L. Robinson.

I send you more proof sheets. I hope you will criticize the authority of my grasses and sedges if it does not meet your approval, as well as the nomenclature.

I see the Kew [Index] has *Habenaria herbeola* R. Br. for *Habenaria viriscens* Spreng, would you advise placing the Kew name first and the Gray name second, or omit the Kew? Also *Betula papyracea* Ait. for *B. papyrifera* Marsh.? Please advise me.

Do you intend to leave the authority of the genus the same as in Gray 6th edition, or revise according to the Kew? I find Gray does not always coincide with the Kew and Britton [and Brown] uses *L.* instead of *Tourn.*

Yours sincerely,
Emma J. Cole

[Note: Cole used *Habenaria viriscens* Spreng, with *H. flava* (L.) Gray as a synonym; the accepted name today is *Platanthera flava* (L.) Lindl.]

LETTER 9

Grand Rapids, May 12, 1900
Dr. B. L. Robinson
Dear Sir:

Inclosed [sic] please find a few sheets of proof. There are a few questions upon which I wish you would advise me. Shall I use *Eleocharis pauciflora* or *pauciflorus*? *Rhynchospora leviseta* or *laeviseta*?

In writing you last winter regarding *Cyperus aristatus* Rottb. whether it should be revised to *C. inflexus* Muhl. you said let it remain *aristata* for the present. You had not decided just what revision you should make. I must know soon for it comes in this proof and must have its place in alphabetical order.

Shall I use *Brunella* or *Prunella*?

Shall I use *Physocarpus opulifolius* Maxim? or *Neillia opulifolia* Benth. & Hook.?

Please return as soon as possible.

Yours sincerely,
Emma J. Cole

[Note: Oddly, *Eleocharis pauciflora* did not appear in the *Flora*, although she had two specimens so identified (was this an accident?); Voss (1972) applied the name *E. pauciflora* to this entity, but it was treated as *E. quinquefolia* in Voss and Reznicek (2012).

The name *Rhynchospora laeviseta* (or *leviseta*) does not appear in the *Flora*, nor does it appear as a published name in Tropicos (2018).

Cole used *Cyperus aristatus* in the *Flora*, now considered to be a synonym of *C. squarrosus*); she indicated *C. inflexus* as the name used by Britton and Brown (1896–1898).

Prunella appeared in the *Flora*.

Cole used the name *Neillia opulifolia* in the *Flora*, whereas *Physocarpus opulifolius* is the accepted name today.]

LETTER 10

Grand Rapids, May 24, 1900

Dr. B. L. Robinson

Dear Sir:

Inclosed [sic] find another set of proof sheets. I have as yet not received the last set I sent you, so I published without your corrections. They were mailey [mailed] May 19th. I hope I am not taxing your time and patience too much. Please return proof promptly if possible. I fear my last did not reach you.

Yours,

Emma J. Cole

LETTER 11

Grand Rapids, June 15, 1900

Dear Dr. Robinson.

Here is more proof. I shall be very glad to send Mr. Fernald my proof during vacation, it is very kind of him to take this extra work when he should be recreating[.] The next set I will mail to him. I wish you a pleasant voyage and a delightful trip and I am sure you will have both. Please return proof as soon as possible.

Yours sincerely,

Emma J. Cole

LETTER 12

Grand Rapids, June 23, 1900

M. L. Fernald.

Dear Sir,

I have a collection of *Antennaria plantaginifolia* Hook. which I should be glad to have you look over if you will kindly do so. I will number them and you may return the numbers of my duplicates.

I also take the liberty of sending you a mustard and a green little plant which I cannot make much out of. I collected them in a meadow near the Fair Ground. I sent the mustard to the Mich. Agricultural College but they were not able to identify it as to its species. Thought the genus was *Sisymbrium*. I hope I am not taxing your patience too much.

Yours,

E. J. Cole

[NOTE: The *Sisymbrium* referred to here is undoubtedly the species called *S. irio* in the *Flora*. Crow (2017) discussed this entry as follows:

Sisymbrium loeselii L. (*Sisymbrium irio* of Cole; Small Tumbleweed Mustard; June 1900 (GH); 13 June 1900, MICH); June 1900 (MSC). Cole suggested that this adventive native to eastern Europe and west and central Asia may have been introduced into Paris Twp., Sec. 19 by use of refuse from the Felt-Boot Factory as fertilizer (see *Verbesina encelioides*), as the factory imported considerable material from India, Persia and Russia). Oddly, however, her letter indicates that the specimen was collected near the Fair Ground, but the label for the 13 Jun 1900 (MICH) clearly indicates Paris Twp., Sec. 19.

See also next letter (June 30, 1900).]

LETTER 13

Grand Rapids, June 30, 1900

M. L. Fernald

Dear Sir

I send my proof hoping you may glance at its nomenclature and see if I have revised correctly. I am sorry to take your time on the eve of so delightful a trip as you are about to enjoy. You need not trouble about anything else. I will make an extra effort to see the errors, if you can find time for nomenclature and its authority. I shall be greatly obliged. Is *Sisymbrium Irio* introduced from Europe? If so it should be in small capitals. Is it introduced to any extent in the U. S.? Any little information I shall be glad to include in my note to the species. The Britton nomenclature I print in italics—the Gray when it differs from the Kew [Index] (which is the nomenclature I publish in). I print in brevier [8-point type] with authority in italics.

Yours respectfully,

Emma J. Cole

P. S. The *Antenarias* I will send after your return. There is no haste.

E. J. C.

LETTER 14

Grand Rapids, July 17, 1900

Mr. Fernald.

I presume my proof will reach you now, so send it. I feel that I must keep as close to the Kew Index as I consistently can, but shall be glad always to make changes in nomenclature whenever plants have been misnamed or when there is a change in American nomenclature by American botanists. I appreciate highly the work you are doing for me. Please return proof at your earliest convenience and oblige.

Yours sincerely,

E. J. Cole

P. S. By an error the manuscript of Leguminosae [Papilionaceae in the *Flora*] has been commenced before Rosaceae has been completed, but I send it along for correction.

[Note: Emma's reference to American nomenclature relates to Nathaniel Lord Britton's application of the American Rochester Code regarding nomenclature, which differed from the European Code which Kew Index followed. Hence, she followed the Kew Index carefully (as did Robinson and Fernald as they were preparing the 7th edition of Gray's Manual), but presented as synonyms the scientific names in Britton and Brown (1896–1898). See Crow (2017) for discussion of Cole's dilemma regarding nomenclature during the production of the *Flora*.

The legumes have sometimes been treated as three distinct, but closely related, families; Cole uses the family names Papilionaceae and Caesalpinaceae in her *Flora* for the legumes instead of a single family Leguminosae (or Fabaceae as the family name in use today, having the –aceae ending. The third segregate legume family, Mimosaceae, has no genera in Michigan.]

LETTER 15

Grand Rapids, August 18, [1900]

Mr. M. L. Fernald.

Dear Sir.

I mail you my specimens of *Antennaria* and some sedges which I have labeled in my lists, for you to see. I presume one at least will have to be corrected. *Euphorbia Presslii* I

presume is *E. nutans* as you suggested. Would you say in the Catalogue that *E. nutans* [take] the place of *E. Preslii* which is not known to occur in the U. S. or leave it as in the proof?

Yours respectfully,

E. J. Cole

[P.S.] I wish you would advise me as to the following changes.

Euonymus obovatus instead of *E. Americanus obovatus*?

Acer nigrum instead of *A. saccharum nigrum*.

Wahoo or waahoo [*Euphorbia*]

E. nutans Lag. (*E. Preslii* Guss.)

Sumach or sumac

Please return at your earliest convenience as I expect to go into the country for a few days after the proof is in. The plants I send you[,] you can look at when you have leasure [sic].

In Haste –

E. J. C.

[NOTE: With respect to the alternatives in the postscript, Cole's *Flora* has the following entries:

E. Preslii Guss. (with *E. nutans* Lag. in italics as a synonym); this name is now regarded as a synonym under *Euphorbia nutans*).

Acer saccharum nigrum

Wahoo

Sumac]

LETTER 16

Grand Rapids, October 26, 1900

Dear Mr. Fernald.

Inclosed find a plant of our *Potentilla canadensis* L. I think during the Summer you corrected it in my proof to *P. ~~striata~~ simplex* Michx. I send you a plant to see if this is the plant you had in mind, flowers small and yellow. The page is to be reprinted and I thought now was the time to change if there is to be one.

Is *Stachys asper* var *glabra* Gray the same as Britton's *S. tenuifolia*? In no 989 shall I use small capitals?

Please look to *Physalis Virginiana*. I think there is an error in Gray. Should it not have been *Pennsylvanica*? I think the catalogue will be completed with two proofs more.

Yours sincerely,

Emma J. Cole

P.S. Do you consider *Brunella vulgaris* an introduced plant?

E. J. C.

[Note: *Stachys asper glabra* is the name used in Cole's *Flora*, with *S. tenuifolia* as a synonym; however, the name in current use is *Stachys tenuifolia* (Crow 2017).

Brunella vs. *Prunella* was a question earlier in Letter 9. *Prunella* was ultimately the spelling used in the *Flora*.]

LETTER 17

Grand Rapids, November 13, 1900

Mr. Fernald

Dear Sir:

I hope you will feel free to add or change notes to *Antennaria*. I know nothing about them. I simply have collected what I considered to be different. I think Prof. Wheeler of Lansing sent my collection of last season to you. So you have seen the entire collection.

Sincerely yours,

Emma J. Cole

LETTER 18

Grand Rapids, November 17, 1900

Mr. M. L. Fernald.

Dear friend:

In writing to Prof. C. F. Wheeler about the two plants in the genus *Scirpus*, *S. cyperinus* *Eriophorum* (Michx.) Britton (*Eriophorum cyperinum laxum* Wats. & Coult.) and *S. microcarpus* Presl. (*S. sylvaticus digynus* Boeckl.) which I sent you during the summer. He thinks we may have both species and varieties. He has been thinking over them lately. If you have these plants still and will be kind enough to mail them to him I should like him to see what I sent you. I studied a specimen of what he called *Eriophorum cyperinus laxum* last winter and could make nothing but *S. cyperinus* out of it, but when he looked over other species of mine he called it that variety. I do not know enough about sedges to be sure of my identification. Yet I generally know when I see different ones and have made my collection and he has identified it. I may not have been so very observing about these plants. If you have not saved these plants it makes no particular difference but if you have them I would like to have them mailed to Prof. C. F. Wheeler ~~Lansing~~, Agricultural College, Lansing, Mich.

I hope I am not giving you too much trouble. When I get this List published I hope you will check the plants you must desire and let me collect some for the Herbarium. I should be pleased to do it. Proof received today.

Yours Sincerely,

Emma J. Cole

[Note: There seems to be a question as to whether or not there are two varieties of *Scirpus cyperinus*; Cole could not distinguish two distinct varieties, but Professor Wheeler thought both might be in her district. Interestingly, she ended up recognizing only one variety (*S. cyperinus* var. *eriophorum*, but not var. *cyperinus*) in her *Flora*. Today *S. cyperinus*, without varieties, is recognized for Michigan (Voss and Reznicek 2012). The other *Scirpus* mentioned in the letter, *S. microcarpus*, is now treated as a synonym of *S. expansus* (Voss and Reznicek 2012).]

LETTER 19

Grand Rapids, November 24, 1900

Mr. M. L. Fernald

Dear friend.

I like the liberty to mail to you these members of *Senecio* if you will kindly look them over and give me your opinion. I presume they are correctly identified, but the group is troublesome. The one labeled *S. aureus* in pencil I found in a wet meadow and these were

summer plants but all small like this. Would you in the “index” to my flora give all the common names (e.g./ *Quercus*. Oak). Are both necessary but would black oak, white oak etc. be of enough value in so small a list as mine be of any especial value? If you will allow me to further intrude upon your time and patience I should like you to see my preface and index. You always see some error which I do not.

Yours,
Emma J. Cole

LETTER 20

Grand Rapids, January 7, 1901.
Mr. M. L. Fernald.
Dear friend.

Inclosed [sic] please find my Introduction. There are still about four pages at the end. Please criticise [sic] general style, plant lists as to orthography &c. You see this publication spans two centuries it ought to be a good omen.

Yours,
Emma J. Cole

LETTER 21

Grand Rapids, January 26, 1901
Dear Mr. Fernald.

I made the changes which you suggested regarding yourself and Dr. Robinson in my Introduction. You were quite right about it. I also united some of the smaller paragraphs. This is the end of my Introduction, I hope you are not getting tired of it, but all trials end and sometime even this.

Yours sincerely,
Emma J. Cole
P. S. Should Statistics of the Catalogue be in such large type? Is it in the best place?

LETTER 22

Grand Rapids, April 14, 1901
Dr. Robinson.
Dear Sir.

I wish to express my sincere gratitude to both yourself and Mr. Fernald for the kindly assistance you have given me on my Flora. If there are any plants mentioned in my Catalogue which you especially desire, kindly let me know and I will try to send them to you. Would it be asking too much of you to give my publication a mention in some one of the Eastern Botanical Journals? [See Robinson 1901.] The sale will be limited and I wish as general a notice as possible. I hope both yourself and Mr. Fernald have received the copies I mailed you a few days ago. You doubtless can see some merits and many demerits as no publication can be perfect or even satisfactory entirely to the writer, yet I trust it may help some who wish to consult it. Kindly thank Mr. Fernald for me for his kindly patience and assistance to the end. Again thanking you I remain

Yours truly,
Emma J. Cole

LETTER 23

Grand Rapids, June 9, 1901

Dear Mr. Fernald:

I hope you do not consider me ungrateful for the assistance you gave me on my Flora, because I have not written to you directly before. I wish to thank you personally now, for I do not know what I should have done without your kindly and ever cordially given assistance. I have been so very busy since the completion of my publication that I have found little time for anything but the work of the day, and the days have been a series of successively busy ones. I hoped to begin a collection of our *Eriophorum*s and *Scirpus* for you about here but I have not been able to do so as yet. Are there any of our plants you would like particularly? If so I will try and send them to you. I should like very much your publication of *Antennaria*. I think you told me you were preparing a paper on that genus. I received your paper on the subject of Botanical nomenclature and was very much interested in it. It was a strong argument well substantiated. I wish to thank you for it. I hope you will have an enjoyable summer. I expect to be in western Pennsylvania for a few weeks after our school closes.

With best wishes for your success.

I remain Yours Sincerely,

Emma J. Cole

LETTER 24

Grand Rapids, December 2, 1901

Dear Dr. Robinson.

I wish to express to you my thanks for a copy of your Denver Address. I have read and reread it with great pleasure and profit. It makes me feel that I can scarcely wait till spring opens to work along some of the lines you have suggested. Thanking you again that you were so kind as to see that I have the copy. I remain

Yours Sincerely

Emma J. Cole

LETTER 25

Grand Rapids, November 12, 1902

Dear Dr. Robinson.

Your publication "Flora of the Galapagos Islands" is at hand. I am very much interested in it. I congratulate you upon your success. Please say to Mr. Fernald that I have read with pleasure his publication on the Birches. Sometime when I am in northern Michigan I might send you some [plants]. Thanking you cordially for your kindly remembrances. I remain

Yours Sincerely,

Emma J. Cole

LETTER 26

Grand Rapids, February 21, 1903

Mr. Fernald.

Dear Sir:

I take the liberty to send you two species of plants which were collected from a field on which Felt-boot factory refuse had been used as a fertilizer at least ten years ago. I am very much interested in collecting these plants from this dry sandy spot and have found

fifteen species. It gives me an idea as to seeds which cling to the wool of sheep and can undergo the processes of the factory and grow here.

I have read your article on the Cranberries in *Rhodora* and have found all three – *V[accinium] Oxycoccos*, *V. oxycoccos intermedium* and *V. macrocarpon* in my own herbarium collected about here. I shall take notice of their occurrence about here in the spring. If you will kindly identify my plants and return, as they are all that I have. The field had been mown and these came from the second growth.

Sincerely yours,
Emma J. Cole

LETTER 27

Grand Rapids, January 21, 1904

Dear Dr. Robinson.

Last summer and autumn I was in Europe traveling with friends, and I collected plants in the British Isles which I can identify by Hooker's student's flora [Hooker 1884]. Now how about my collections in France, Germany, Switzerland and Italy? Are there in these countries floras similar to Gray's [Gray et al. 1890] and Hookers in the language of the country I mean? Will you kindly give me names of Floras (with the comparative price)[?] I wish to identify my collection as far as possible myself. I have about four-hundred specimens in all. One hundred sixty from the British Isles which I have just been going through. Any information upon this subject will be gratefully received. I suppose you are well and as busy as usual. I am in school again and my work goes all the better for having left it for a while after twenty-three years of constant service.

My best wishes to yourself and your assistants for the New Year which we have just entered.

Sincerely Yours,
Emma J. Cole

LETTER 28

Grand Rapids, November 1, 1907

Dear Dr. Robinson

I have about finished my observations on *Arisaema Dracontium*. I spoke to you about my study of it when I saw you several years ago. You may have forgotten it however. If you can command the time will you kindly look over the manuscript which is not long and suggest other observations and criticise [sic] savagely the manuscript with its observations. I have not quite finished my observations, but you may think of others which would be interesting. I will also inclose [sic] the photographs so far as I have them.

I hope I do not solicit more than you with limited time will feel [or find] to grant.

Sincerely yours.
Emma J. Cole.

[Note: This letter regarding Emma Cole's manuscript on *Arisaema dracontium*, then under preparation, was sent to Dr. B. L. Robinson, then editor of *Rhodora*, journal of the New England Botanical Club. The article was not published during her lifetime, but was ultimately published in the first volume of *The Michigan Botanist* (Cole 1962). E. G. Voss, editor of the journal, discovered the manuscript among the effects of Dr. Harley Harris Bartlett (1886–1960), late professor of Botany at the University of Michigan, while clearing out his office. Voss added a footnote to her article indicating that the manuscript required almost no editorial changes. This letter helps explain this "anomaly" of Voss making few editorial changes, as he was well known to have an especially critical editorial eye. Surely B. L. Robinson complied with her request to "savagely" criticize her manuscript; one only wonders why it had not been published in *Rhodora* back then.]

APPENDIX 2. Letters from Emma Cole to her proofreader, Luther Samuel Livingston (1864–1914). Transcribed from unpublished handwritten letters in Gray Herbarium Archives, Harvard University Herbaria Botanical Libraries (photocopies obtained by J. Stivers on March 13, 2007). Luther, an alumnus of Grand Rapids City High School, Class of 1881, was by 1900 a rare book dealer and bibliographer in New York City who had also worked for Pitcher & Manda's The United States Nurseries in Short Hills, New Jersey, as a compiler of horticultural catalogues, and was sent by his employers as a collector of live orchids in Colombia. He proofread the entire manuscript of Cole's *Flora*. As he was proofreading sets of page-sheets, it prompted him to reminisce about some of his botanical forays in the Grand Rapids area and to provide handwritten notes on several plants he had collected or observed in 1885 and later (see below after Cole's letter June 15, 1900).



FIGURE 5. Luther S. Livingston, Grand Rapids City High School Yearbook Delphian 1896, representing 15-year reunion, Class of 1881 (Photo 1896; source: Grand Rapids History & Special Collections, Archives, Grand Rapids Public Library).

LETTER 1

Grand Rapids, December 24, 1899

Luther S. Livingston.

Dear friend.

The "Flora" I hope will soon be in the hands of a publisher and I have in kindly remembrance "a promise," that if possible you would assist me in looking over the proof. Are you too busy to do so? It will come in 16 pages or its equivalent about once in two weeks or so. I shall esteem it a great favor if you can do so as I have never read proof. I will struggle along with the first if you think best. Do not let me interfere with your plans if it will not be perfect convenient.

Yours,

Emma J. Cole

LETTER 2

Grand Rapids, February 23, 1900

Luther S. Livingston:

Dear Friend.

I include the proof of the first sixteen pages of the Catalogue. I am having this printed first as the Introduction will be comparatively easy for the printer. It gives me so much courage to know it will pass through your hands before it passes to the printed page and thence to the world.

The diphthongs I have printed as single letters and the comma between the species and its authority I have omitted following Dr. Britton in these respects at the advise [sic] of Prof. Wheeler of the M.A.C.

The nomenclature is that of the Kew Index which in the main is that of Gray. When it differs, that of the Gray is in parentheses. The Britton & Brown [synonym] is in italics. When the change would be simply a gender ending it has not been added.

I shall have it printed on book paper (without gloss) and I hope it will come out satisfactory to everyone interested. I hope you will feel free to suggest or make such changes as you think would be a benefit.

I thank you most heartily for your assistance and I hope I am not asking too much with your limited time. Remember me to Mrs. L. and tell her I know she will be vexed to have me trespass upon her husbands [sic] leisure, but that it will not last forever as there are only 1309 species in the Flora.

The plants with a catalogue number are supposed to be established. Those without a number are here but adventive.

In the Catalogue I have mentioned your name to your notes instead of initials as I have done in the cases when the name appears occasionally.

Yours sincerely,

Emma J. Cole

LETTER 3

Grand Rapids, March 18, 1900

Dear Luther.

After much delay my proof is in page form. You need not apologise [sic] for criticism. This is just what I desire. I hope you will always feel free to do any amount of it. I know you feel interested in the publication and are anxious to have it come out all right. I feel that you go through the proof in the most thorough manner. You do not glance it over and

return it with all its mistakes. You are just the proofreader I need and I feel, after it has gone through your hands, a confidence in it. I have never read proof or superintended publication so I have many things to learn. I have acted upon your suggestions as far as I have been able to do so.

About the intending [sic] we have all talked and thought about it, but have concluded it will look none the better in the whole. I have set the number [of the species] out which relieves somewhat the square front. The lines are many times short and the right hand page will be broken at first.

The common names I have taken from Gray and have printed them after his method. You see I cut up Mich. Floras and pasted the names on cards to aid my printer, as my writing is not legable [sic] at best. As to the genera credited to Linn. instead of L. they were so given in the Kew – and it really makes little difference. All the same I want your suggestions whenever you notice anything in this line. I hope my work will progress a little faster now the Covered Count is about through. My printer works on briefs &c.

Miss Dean is well. Miss Clark is in the City and will remain till summer I think. I talk to your sister Jennie through the Phone occasionally. We are having our winter now, a real blizzard. School goes off nicely, but my classes are larger than in the fall. I hope you and Mrs. L. may visit G.R. before many months, and that I may have the pleasure of entertaining you. If you will look over the proof – suggest, and return as soon as possible. I shall be greatly indebted to you.

Sincerely your friend.

Emma J. Cole

P.S. The printer has added from 107 to make up the 16 pages. Will you be so kind as to look these over.

Yours, E.J.C.

LETTER 4

Grand Rapids, April 10, 1900

Dear Luther.

I send a few more proof sheets, also a copy of the first sixteen pages. I thought you might wish to look back for some things for uniformity, so mark this up as you wish and I will send you a copy friend [unclear, bound?] when it is all complete. The Rouge River was so called because of its reddish water, but soon became pronounced rogue because at Plainfield so many reckless characters gathered, but it still retains its original spelling.

We are having fine weather here now. The robins are singing and the maples are coming into bloom.

Yours sincerely,

Emma J. Cole

LETTER 5

Grand Rapids, May 12, 1900

Dear Luther.

Inclosed [sic] find more proof. My printer is slow you will see but he wants everybody else to get in a “hustle” so if you will return this as early as possible it will please him. He says you have “awful sharp eyes” to see all the errors. I hope you will continue to have [eyes] for I am not used to proof but I see I am improving. You will see that the “Cs” are out but I will see that they get in in their proper place. I telephoned your sister Jennie yesterday. She is well. When do you go to N.C.?

Yours,

Emma J. Cole

LETTER 6

Grand Rapids, May 24, 1900.

Dear Luther.

Here is another set of proof. I will give you a credit mark for your promptness. The notes pertaining to yourself and Bert [Burton Livingston], feel free to change or correct as you think best. My printer is willing but not so responsible as he might be for his own work, yet it seems to be coming out fairly well with all the work I have done upon it by my friends. I left the “¼” as Mr. Fallass thought it was a little better so than written out, but I thank you for the suggestion. He has much of his work as a lawyer. Correct or criticize freely.

Yours,

Emma J. Cole

[over]

M[r]. Railuel [sic] found *Arisaema Dracontium* in 1891. I visited the spot in 1898 and it was still there. The creek bed has turned and it is left on a kind of island, so the cattle will not be able to destroy them.

E.J.C.

[Note: Cole has the name as “Edward Raiguel” in the *Flora* under *Arisaema Dracontium* (p. 39).]

LETTER 7

June 15, 1900.

Dear Luther.

Your letter with those delightful notes came to hand in due time. I could feel just how you went in memory from place to place with your brother Lincoln and enjoyed the scenery, the birds, butterflies and flowers. I shall incorporate all of your notes with my data and they will be put aside for reference. I wished so much to put in your brother's name but I could find no convenient place without leaving out your own and this I did not wish to do. The plants which do not grow in our district (within the tiers of townships about the City) I do not give a number, but several grow only a few miles without so I inserted them without a number—and those plants not considered established it is customary not to number. Then the Catalogue does not seem padded to give a large flora. Ours is 1263 with numbers. So you see we have probably the largest flora for the territory in the State. Professor Wheeler thinks so. I forgot to write you about my plan of numbering in my last letter. I hope my proofs will not come so long apart during vacation[;] the printer I think will have more time to give to my work then. Please return as soon as possible.

Yours sincerely,

Emma J. Cole

P.S. Is sand bar a compound word?

Luther S. Livingston Notes

Luther S. Livingston sent the following notes, which Emma Cole's letter of June 15 (above) refers to as “those delightful notes.” Some numbers from the proofs written by Luther's hand were changed in final printing; the correct numbers, as they appear in the *Flora*, are in brackets; Also added in brackets are common names and current scientific names (per MICHIGAN FLORA ONLINE 2011):

373 E[rythronium] albidum [White Trout Lily]

In the Spring of 1885 I gathered quite a bunch of flowers, 40 or 50 blossoms I should say now, in the field in the north west angle of the junction of the Lake Shore and C. & W.M. [R.R.]. The "Thoas" field we called it because there, in the summer of 1880 E. A. Rennick and myself had captured specimens of a *Papilis* unknown in that region for twenty years and which we identified as *P. Thoas* (tho' it was *P. Cresphontes*). It afterwards became common.

[Note: This was *Palilio cresphontes* (Giant Swallowtail), similar to *P. thoas* (Thoas Swallowtail).]

376 L[ilium] Philadelphicum [Wood Lily]

In the summer of 1885 I gathered these on the hill above Cedar Swamp.

377. L[lilium] superbum [Michigan Lily, now *L. michiganense*]

In the summer of 1876 I remember that in the swamp west of the C. & W.M. [R.R.] just below Plaster Creek there was a most notable patch of these lilies very tall and with immense spikes. We gathered them there in after years also but they gradually died out.

390 [389] *Tofieldia glutinosa* [False Asphodel, now *Triantha glutinosa*]

Gray has this *T. glutinosa* Willd. [instead of "(Michx.) Pers." in the *Flora*]

394 [392] T[rillium] rivale

For a number of springs, certainly from 1882 to 1886 my brother Lincoln and myself annually gathered these on the north bank of Plaster Creek between the M. C. and G. R. & I. [RR.]. For most of these years if not for all it was our earliest flower preceding *Hepatica*, *Ranunculus* or *Erigenia*. In my mind now I can see exactly the position in which they grew, and most abundantly, in thickets where the dead leaves showed that during high water the creek had flowed over the ground. Prof. Moseley was with us when he gathered them in 1885. This little *Trillium* was one of my favorites. I never saw it elsewhere and have not seen it since I left G. R.

402 [400] A[rethusa] bulbosa [Arethusa]

The first I saw were gathered by my brother Lincoln in the spring of 1882 or 1883. We gathered them every spring as long as I was in G. R. They grew in the soft mounds or cushions of living sphagnum, never were very abundant but, I presume we have gathered 30 flowers in a season.

I think "In sphagnum in Orchid S[wamp]." would be better than in bogs because they did not grow in really boggy places as did the *Calopogon*, for instance.

Note: [Emma took his advice. She added to her *Flora*: "L. S. Livingston and Prof. R. H. Wolcott report this species as having been rather abundant in this swamp [Orchid Swamp—now extinct] in the eighties. In 1898 seven plants were found (O.H.) [Homer Skeels & Jennie Shaddick, Our Herbarium]."]

403 [401] C[alopogon] pulchellus [Grass Pink, now *Calopogon tuberosum*]

The east margin of the lake in Orchid Swamp was red with flowers so they could be gathered by handfulls in 1882 to 1885 or 1886.

406 [04] *Cypripedium* acaule [Moccasin Flower; Pink Lady-slipper]

In 1885 my brother Lincoln B. L. found a specimen in Saddle Bag Swamp with a double lip, the lower flattened the upper inflated and resting upon the lower. One lip was not within the other. The next day I went out there and gathered a basketful, certainly 200 or 300 of the blossoms. They were all in a little patch of tamaracks south of the R.R. track and growing in the mude [muck] ground around the roots of the trees. Between the trees was water in which I waded in gathering the flowers. Here in the East I have gathered them up the Hudson [River] near Cornwall [N.Y.], near Short Hills, N. J., at Atlantic Highlands [N. J.], on Staten Island [N.Y.], and in Western North Carolina, always in high dry situations.

407 [405] *Cypripedium* candidum [White Lady-slipper]

My memory is perfectly clear as to this. I could go to the exact fence corner and the exact bush (now gone or a tree) under which I found those plants. Only a day or two before I had first found them, and Oh? in what abundance in the low ground West of Lamberton Lake. There I had gathered a basketfull [sic].

408 [406] *Cypripedium* parviflorum [Small Yellow Lady-slipper, now *C. parviflorum* var. *makasin*]

I gathered a large bunch (thirty or forty stems I should say) in Cedar Swamp in 1885.

409 [407] *Cypripedium* pubescens [Yellow Lady-slipper, now *C. parviflorum* var. *pubescens*]

Where one of the hills was cut through by the DGH&M RR about three miles out on the R.R. property beside a telegraph pole there were four or five fine large plants each having from 20 to 50 flowers. We gathered the flowers two or three years (1882 to 1884 or thereabouts) and some of the plants flourished in our garden for several years.

410 [408] *Cypripedium* spectabile. [Showy Lady-slipper, long known as *C. reginae*]

More than one year I have gathered an armful of these fine orchids in Orchid Swamp. 1882 or 1883 to 1885–86. Even as late.

412 [410] *Habenaria blephariglottis* [White Fringed Orchid, now *Platanthera blephariglottis*]

We gathered this in large quantities growing in living sphagnum in Saddlebag Swamp from 1885 to 1887.

414 [412] *Habenaria* ciliaris [Orange Fringed Orchid, now *Platanthera ciliaris*]

This was never abundant but annually for five or six years 1881 or 1882 til 1887 we gathered a few spikes in the triangular point of Orchid Swamp as you first enter from the road. It was not really swampy there but among the ferns and huckleberry bushes were a few plants. Farther down the road, along the foot of the hill just before you come to the first fence, just along the lower edge of the road among tall ferns were a few more plants.

It was in a similar situation along the East Edge of Button Lake [Emerald Lake] (at the foot of the hill, along the lower side of the road) that I gathered them in 1885.

415 [413] H[abenaria] dilatata [Tall White Bog Orchid, now *Platanthera dilatata*]

On a little hummock a foot or two from the bank, at the end of the lake near the hill in Orchid Swamp, I found two spikes of this orchid in 1885. I so classified it and I am sure now that it was correct. It is possible that Burt still has the specimen. The flower had a most delightful spicy odor like many of the tropical orchids.

[MICHIGAN FLORA ONLINE (2011) states: "The flowers have a strong spicy fragrance, suggestive of cloves."]

421 [419] H[abenaria] psychodes [Purple Fringed Orchid, now *Platanthera psycodes*]

We gathered fine specimens year after year along the M. C. RR. south of Burton Ave.

427 P[ogonia] ophioglossoides [Rose pogonia]

In the good old days this was abundant in Saddlebag, blossoming with H[abenaria] blephariglottis [now *Platanthera blephariglottis*].

L. S. Livingston
[June 1900]

LETTER 8

Grand Rapids, July 17, 1900
Dear Luther.

I hope you will not forget my proof this time. I waited as long as I could for the last proof, and began printing, but fortunately I got your corrections in. By an error in giving the wrong manuscript I have some plants in Leguminosa [Leguminosae = Fabaceae] before Rosaceae is finished, but there will be less to look over next time.

Yours,
Emma J. Cole

LETTER 9

Grand Rapids, August 18, 1900
Dear Luther,

Will you be so kind as to run over the printed pages and note the corrections which should go in the errata at the end of the catalogue. I presume the scientific terms are in the main correct. You need not hurry but when you find time just glance it through. I pity you in this unique heat.

Yours sincerely,
E. J. Cole

P.S. Please be as prompt as the last two times if possible as I wish to go in the country.
E.J.C.

LETTER 10

Grand Rapids, October 26, 1900.
Dear Luther:

If you can begin the looking over of the printed part of the catalogue for errors, at your leisure and be ready by the time the two proofs after this are ready, which we hope will be finished by Dec. then you can report with the last catalogue proof. The common names

included with the synonym should have been out of the parenthesis but it was not noticed until it got in several times, and as it will not probably occur more than twice more, I thought it best to have it uniform. I am sorry I did not notice it at first. We are having beautiful weather. You would enjoy our woods now.

Yours Sincerely,
Emma J. Cole

LETTER 11

[Grand Rapids], November 19, 1900
Dear Luther.

If you have the errors noted you may send them so far as completed with the proof. I congratulate you on the prospect of such a delightful time.

Yours Sincerely,
Emma J. Cole

LETTER 12

[Grand Rapids], November 24, 1900
Dear Luther.

I hope you will see me through the Preface and Index. Your “sharp eyes” always see some errors that I have overlooked. Would you index to all the common names (e.g.) Quercus, Oak are both necessary but is white oak, black oak &c. in so small a “list” as this? I congratulate you in your new home. I know you will be very happy with so much of God’s own earth about you. Miss Dean has taken her place for half day work in the Central again. Miss Clark is at the ____ [unintelligible] and is having trouble with her eyes. So she feels somewhat lonely.

Yours,
Emma J. Cole

LETTER 13

Grand Rapids, January 7, 1901
Dear Luther,

Inclosed [sic] please find my Introduction. I hope you will feel free to criticise [sic] where you think it needs it. What do you think of the size of the headings and then subdivisions. There are about four pages more, mostly on summing up & explaining the Catalogue. I inclose [sic] a rough outline of my cover to be printed on a gray drab in black.

Yours,
Emma J. Cole

LETTER 14

[Grand Rapids], January 26, 1901
Dear Luther,

You need make no apologies for your criticisms. They are just what I need and desire, and I should be vexed with you if you were not frank. So make as many as you think the proof needs. I want it as good as I can make it.

Bert [Burton Livingston] sent in his article published in the Botanical Gazette. It is

fine. He is real scientific and scholarly and I am proud of him. Soon you will hear the birds in your trees and the breath of spring will be with you and you will be very happy in your "wild" wood home." I inclose [sic] copy of cover and title page. Make any suggestions you wish.

Yours sincerely,
Emma J. Cole
[over]

What do you think of the type of statistics of the Catalogue[;] is it in the right place (ie[.] the statistics?)

Should I make explanations of the Plan of the Catalogue one of my general headings as, Climatic Influences &c., Geology, [T]opography and Soil?
E.J.C.

[Note: Regarding his "wild" wood home: "In 1898 Luther married Flora V. Milner of Deer Lodge, Montana, a friend of his boyhood. Mr. and Mrs. Livingston made their home at Scarsdale, nineteen miles north of New York City. There he found three acres of woods, cliffs, swamp, and proper soil for the garden into which he put the happiest part of every week. Under his wizard touch, this little country home lot became a botanical museum" (Winship 1914).]

LETTER 15

Grand Rapids, March 20, 1901
Dear Luther.

Would you like on the Cover the "Grand Rapids Flora" printed in dark heavy plain letters better than the fancy type?

On the title page would you place "Grand Rapids Flora" so near the top of the page? Do printers punctuate the cover and title pages now?

Say all you like by way of criticism. The cover will be a drab gray I think.

Yours,
Emma J. Cole

LETTER 16

Grand Rapids, April., 10, 190[1]
Dear Luther,

Your letter came yesterday and it is a satisfaction to know you think my Flora very creditable. When I began the work I had had no experience in a printing office. Had I had as much foresight as I have had now of experience, I fear I should not have attempted it. It has come out very well, for I have had the very best assistance I could have had.

The cash outlay for map and printing was about \$226.00. My expenses for my summer vacations, horse hire &c. brings it to about \$550.00. The books are listed at \$1.00 net and Lyon, Kysner & Palmer have the selling of them.

It is expected that libraries will purchase them, and small numbers of copies will be used as reference in the surrounding counties. My pupils will buy a few copies, especially those who wish to make collections or continue the work. Copies will be placed in private libraries, but the sale will be limited and the thousand copies are supposed to be sufficient to supply the demand for the next half century.

Systematic botany is not in its "palmy days" at present, it is now considered not "up to date." But it is in my judgement [sic], the right way to interest young people in the study of nature, the influences of the woods, the flowers and the fields will be life lasting. It was

not a financial speculation on my part that led me to publish the Flora. I could do it, and I felt owed it to the department. I have enjoyed preparing it and as time passes the little annoyances of publishing will have passed away and the memories of the past six years of collecting material for its publication will be among the very pleasantest of my life. Your letter came too late to use your advice about the word "Catalogue" in the title page, as to Mr. Van Dort's name, I promised him when I made my agreement with him that his name might appear there so I must keep my word. He quite prides himself on the mechanical work of the book. I think the notice in the Press pleasant so send it to you, also one of the circulars; you see I have so little fame that I must tie to my friends who have it. I wish to express my sincere thanks to you for your kindly assistance. You can never know how much it has helped and comforted me during the past fifteen months. I mailed a copy of the Flora to Bert [Burton E. Livingston], he thinks it will be quite helpful in his next summer's work in the county. The State Geologist wished two copies. The spring is very late in bringing forth vegetation. The Skunk Cabbage is out but the hepatices in our garden are in their sheathing bud-scales and they are usually out before those in the woods. The arbutus is still in bud. I hope you will kindly preface my correspondence with you regarding the Flora with ample apologies, for, if it goes down to your posterity, I fear my scribbling will not be looked upon so kindly as it has been by their forefather. My closest friends have long warned me against my careless manner of writing, but of no avails and lo, now my retribution is surely, is surely at hand.

I hope my correspondence with you will not cease now that the Flora is completed. I shall always be very glad to hear from you and of your prosperity.

Kindly remember me to Mrs. L.

Sincerely your friend.

Emma J. Cole

APPENDIX 3. Letters from Dr. Charles S. Sargent (1841-1927), Director, Harvard University Arnold Arboretum, to Emma Cole. Sargent served as the first director of the Arnold Arboretum and is especially known for his 14 volume *Silva of North America* (1890–1902) and *Manual of the Trees of North America* (first edition 1905, second edition 1922). During this time of correspondence with Emma Cole, Sargent was especially focusing on the difficult and diverse genus *Crataegus* and greatly appreciated her assistance in these studies. Typewritten copies of unpublished letters in the Correspondence of C. S. Sargent, Archives of the Arnold Arboretum of Harvard University. (Photocopies obtained by J. Stivers on January 26, 2007).



FIGURE 6. Dr. Charles Sprague Sargent, Director, Harvard University Arnold Arboretum (Photo ca. 1910; source: Arnold Arboretum Horticultural Library of Harvard University).

LETTER 1

Grand Rapids, May 1, [1906]
My dear Miss Cole:

I am back again after a splendid journey in South America where I have enjoyed myself immensely and obtained a good deal of useful material for our herbarium. Now that I am back I have got to think about *Crataegus* again. I want if possible to be able to get out next winter a paper on some of the Michigan species, so if there is any more work to be done in your region this season I hope you will do it, and, if you can extend the region, so much the better.

Let me hear that you are well and still enthusiastic about *Crataegus*.

Faithfully yours,
C. S. Sargent

LETTER 2

Walker Station, August 23, [1906]

Dear Miss Cole:

I am very pleased to get a letter from you again and to learn that your health is restored as well as your zeal for botany.

I have been working a good part of the summer on very large collections of *Crataegus* from the neighborhood of Buffalo and Niagara Falls, and from different places in Ontario. I have done about all I can on these so far and now have commenced on Dodge's collection. What I should like to do, if possible, is to combine your plants with Dodge's into one Michigan paper. I mean to go out to see Dodge this autumn if I can, and it may be desirable to pay Grand Rapids another visit. It would certainly be a great pleasure for me to do so.

I am most anxious to get all this material that has been accumulating for so long off my hands, especially as so many of your species are now growing in the Arboretum, but as the number of described species increases the difficulty of describing new ones becomes greater. Altogether the situation is becoming difficult. Fortunately I am in good condition this summer in spite of the heat which has been uncomfortable owing to too much moisture. When do you expect to be back in Grand Rapids?

Faithfully yours,
C. S. Sargent

LETTER 3

Grand Rapids, January 22, [1907]

Dear Miss Cole:

I am now working on a paper about Michigan Thorns and I shall try to include in it some of the most distinct of your Grand Rapids' species. Names are very hard to find, so possibly you can give me the names of some individuals who have been in some way or other connected with Grand Rapids' botany whose names might be used for the names of species. How about the man who wrote *The Flora of Southern Michigan*, published by your Academy, which you got from me the other day? If you can send me half a dozen appropriate names, they will be of great help.

Faithfully yours,
C. S. Sargent

[Note: The man referred to here is Nathan Coleman, who spent two years teaching in Grand Rapids and, at the request of the Kent Scientific Institute, researched and published a catalogue of the flowering plants of southern Michigan (Coleman 1874). For additional information see Lammers (2016) and Crow (2017).]

LETTER 4

Grand Rapids, January 23, [1907]

Dear Miss Cole:

Your # 61, a *crus-galli* species, I used to consider *C. Crus-galli*, Linnaeus. Now that species is broken up it may be something else. Can you tell me the color of the anthers? Unfortunately I have no note of this.

Faithfully yours,
C. S. Sargent

LETTER 5

St. Louis, Michigan, January 30, [1907]

My dear Miss Cole:

I am distressed indeed to hear that you are laid up and under treatment. I hope a long rest will do you good. I am sure it will. It won't do for you to get sick now just as we are getting on to work on Michigan *Crataegus* in earnest.

I am describing a few of your most interesting species but there are many that I do not want to take up until after I have visited Grand Rapids again. This I ought to do next autumn, but of course if you are not there it would be useless for me to try to find your numbers, so it seems to me that it is up to you to get well and get back all your *Crataegus* enthusiasm. Drop me a line sometime and let me know how you are getting on. Your handwriting does not look as if there was much the matter with you.

Faithfully yours,
C. S. Sargent

LETTER 6

Grand Rapids, February 13, [1907]

My dear Miss Cole:

I believe that I have done now all that I can do to the Michigan *Crataegus* paper this year and I shall soon send it to the Michigan Academy which meets next month. It contains 54 species; of these 20 are now first described, and 19 have been previously imperfectly described by Ashe and are re-described by me in this paper. Altogether there are 32 of my species and 3 by older authors. The following are of your collecting:

- C. attenuata*, Cole 16 and 19,
- C. perampla*, n. sp., Cole 76 type,
- C. horridula*, n. sp., Cole 138 type and 79,
- C. parvula*, n. sp., Cole 120 type,
- C. latisepala*, Ashe, Cole 170 and 170-1
- C. bellula*, Cole 135,
- C. allecta*, n. sp., Cole 18 type, 70, 139 and 146,
- C. merita*, n. sp., Cole 29 type, 30 and 31,
- C. perlita*, n. sp., Cole 132 type,
- C. mollipes* n. sp., Cole 191 type,
- C. pura*, n. sp., Cole 26 type, 149-1, 155,
- C. Wheeleri*, n. sp., Cole [handwritten insert] 103-1, type,
- C. pusilla*, n. sp., Cole 66-2 type, 66-1, 66-3,
- C. Bealii*, n. sp., Cole 116 type, 116-1, 46, 46-1, 103,
- C. Dodgei*, Ashe, Cole 126, 126-1,
- C. urbana*, n. sp., Cole 3 type, 3-1, 3-2, 6
- C. Coleae*, 8-1 type,
- C. honesta*, n. sp., Cole 4, type, and 5,
- C. penguin*, n. sp., Cole 161 type, 162, 164, [spelled *C. pinguis* when published]
- C. tomentosa*, L., Cole 11 and 42.

You see that this leaves many of your numbers undescribed, especially in the *Pruninosae*, of which you made a very large collection, and in the *Intricatae*. You will notice that I have already described three new species of *Intricatae* but I suspect that you have two and perhaps three more. This group particularly needs further study, as does the Pru-

inosae and Tenuifoliae. In fact Grand Rapids is one of the best places I know now to further investigate *Crataegus*.

I hope that this will find you very much better in health and I shall hope to hear that you are soon returning to your home entirely restored and ready for a record-breaking *Crataegus* campaign.

Faithfully yours,
C. S. Sargent

[Note: see Crow (2017) for updated taxonomy of the genus *Crataegus* for the Grand Rapids area, including taxa published subsequent to the appearance of Cole's *Flora*.]

LETTER 7

Grand Rapids, April 19, [1907]

Dear Miss Cole:

I hope you have recovered and are back in Grand Rapids and ready for some botanical work this spring. There seems to be still considerable to do, and if I hear that you are in condition for some light spring work, I shall write you in detail just what is needed.

I have not heard anything yet of the proof of my Michigan article but I daresay it will be here before long.

Faithfully yours,
C. S. Sargent

LETTER 8

Lowell, May 6, [1907]

Dear Miss Cole:

Your letter of the 24th of April was duly received. I am sorry to hear that you had to give up your school because I am sure that you will miss the work, still your reasons for doing so seem to be good.

I have been looking over again some of your Grand Rapids' material and I find that there is special work to do in the Intricatae. I have described three species in this group collected by you at Grand Rapids, but I have the following material which I could not satisfactorily refer to any of the three.

- # 69, stamens 10, anthers white.
- # 45, stamens 10, anthers pink.
- # 68, stamens 10, anthers pink.
- # 101, stamens 10, anthers white.
- # 102-3, stamens 10, anthers white.
- # 106, stamens 10, anthers white tinged with pink.
- # 110, stamens 10, anthers pale pink.
- # 116, no flowers.
- # 113, no flowers.
- # 25, stamens 8 to 10, anthers pale pink.
- # 66, stamens 8 to 10, anthers pale pink.

I think that if you are able to do so it would be a good plan to make a study of all the plants in this group, comparing them carefully as to the number of stamens, color of the anthers, etc., and, if necessary, remarking them, then in the autumn if I am fortunate

enough to be in Grand Rapids we can go over the plants again. It is especially important to collect flowers of those numbers of which flowers have not been collected.

In other groups I am interested in 148, a mollis species with ten stamens and red anthers. No fruit of this has been collected. It seems to me to be undescribed.

In the Flabellatae # 5, with five to ten stamens and purple flowers, also seems to be new. There is no fruit of this. Of # 28 in the Flabellatae there are no flowers.

In the Pruinosae there are flowers of 60 and 117.

In the Tenuifoliae there are no flowers of # 3 collected by you and me September 23 1901; and of # 75, also collected by us September 25, 1901, there are no flowers.

Besides the above you have many Pruinosae that have not yet been determined, but of these we seem to have abundant material of both flowers and fruit. I shall want to see the plants again, however, before finally deciding about them. Do not undertake to do too much work but, if you can, get the flowers of numbers [of the specimens from the specific trees] of which flowers have not been collected it would be well to do so.

The Intricatae Group is especially interesting to me because you have so many species and because this is a group which is mostly confined to the Atlantic states. Your region is the furthest west, with the exception of a station for one species in Missouri.

Faithfully yours,
C. S. Sargent

LETTER 9

Lowell, June 19, [1907]
My dear Miss Cole:

I am very pleased to get your letter of the 16th and to hear that you are progressing so well and have been able to continue your botanical work. Many thanks for your information about the various numbers.

Your number for what I call *C. mollipes* is 121, not 191.

103-1 which you ask about I do not seem to find; nor do I find any # 75 except that collected by you, a Pruinosae species with ten stamens and purple anthers.

I am going abroad in a few days for a short absence in England and I think you had best hold on to all the material you have collected this spring until the autumn, when I shall hope to see you that we may settle up in the field a few of the questions still unsettled relating to your species.

I hope you will have a very pleasant summer and continue to improve.

Always faithfully yours,
C. S. Sargent

LETTER 10

St. Louis, Michigan, August 16, [1907]
Dear Miss Cole:

I am back from Europe and have begun to write out descriptions of your undescribed Grand Rapids material so that I can take them with me this autumn in case you are able to devote a day or two to going over your numbered plants with me again.

In writing a description of your # 75, a pruinous species, with ten stamens and pink anthers I find that a flowering specimen collected May 18, 1903, has leaves that are broad and rounded at the base, while the fruiting specimen of this same number collected October 1st, 1904, has leaves narrowed and cuneate at the base. This fruiting specimen looks

as if it might be a small-leaved *C. bellula* although the fruit is rather more obovate. Is there not some error here?

I hope you are quite well again and ready for a little more work. I feel strongly that we ought now to finish up all the material which you have been collecting and studying for so many years in the neighborhood of Grand Rapids. As you know, many of your species are already described in the Michigan paper which I had hoped to find here but which apparently has not yet seen the light of day, at least so far as I know.

Faithfully yours,
C. S. Sargent

LETTER 11

Grand Rapids, August 31, [1907]

Dear Miss Cole:

I wrote you a couple of weeks or so ago on my return from Europe but as I received no reply to my letter I am afraid it did not reach you.

I am anxious that you should meet me at Grand Rapids about the 22d of September and go over with me in the field your numbers which are still undescribed. Of course if you cannot do this, it would be useless for me to go to Grand Rapids as I could never find your numbers. I have already written out preliminary descriptions of all the plants I want to see, so it ought not to take so very long over field notes.

Please let me hear from you as soon as possible.

Faithfully yours,
C. S. Sargent

LETTER 12

Lowell, September 4, [1907]

Dear Miss Cole:

I have written you two letters. The first one was wrongly addressed and has been returned. Perhaps it is not time for an answer to the second which I sent to Grand Rapids. Now Dodge writes me that you are at Lowell, Michigan, so I send this line there to tell you that I count on your meeting me at Grand Rapids about the 22th for a day or two over some of your *Crataegus*. I have written out preliminary descriptions of all your numbers that are not in my first Michigan paper, so that if you can still find the plants it ought not to take very long to do what I have to do there. Of course if you cannot meet me it will be hopeless for me to go to Michigan this year, but I very much hope that you can as I am anxious to finish up now the Grand Rapids species.

Faithfully yours,
C. S. Sargent

LETTER 13

Lowell, September 5, [1907]

Dear Miss Cole:

I am glad to hear that you are in such good condition and ready for *Crataegus* work this autumn. The numbers of which I have written out descriptions are,—

3-1, May and Sept. 1905. # 32, Sept. 1902, and May and Oct. 1905, seems to be the same.

3-2 and 3-3, May 20 and Oct. 3, 1901.

32, May 1901, May and Sept. 1904. 158, Oct. 17, 1904, seems the same.
117, May and Sept. 1901, June 1907. # 60 is probably the same.
32-1, May and Sept. 1905.
142, Sept. 1901, May 1903, Oct. 1904.
80, May and Oct. 1905.
157, Oct. 1904, May 1905.
168, May 32 [sic—probably May 5] and Sept. 20, 1905.
86, May and Sept. 1902. # 44, Sept. 1902 and May 1903, seems to be the same.
75, May 1903 and Oct. 1904. # 168, May and Sept. 1905, is probably the same. # 74, flowers only, is also probably the same.
37, May and Sept. 1902.
13, May 1901, Sept. 1902.
124, Sept. 1901, May and Sept. 1902[.]
151, Sept. 1904, May 1905.
12, May 1901, Sept. 1902.
38, May and Sept. 1902.
1 Sept. 1900, May 1901 and Sept. 1902.
5, May 24, 1904. # 147 of 1903 and 49, May 1905, appear to be the same. There is no fruit of any of these numbers.
167, May and Sept. 1905.
148, May and Sept. 1904.
102-3 and 113, Sept. 1904, June 1905.
45, June 1901, Sept. 1902.
69, May and Sept. 1901, Sept. 1902.
110, 106, May and Sept. 1901.
06, 25, May 1901, Sept. 1902, May and Sept. 1902, Sept. 1904.
94.x[?], May and Sept. 1901.

These numbers are all of which I have written descriptions. We ought, however, to look at the following: 96, 36, 22, 15, 125, 116-1. So you see we still have a good deal to do.

Would it be all right if I telegraphed you to Lowell a couple of days before I expect to reach Grand Rapids? I now expect to leave here September 16th before and stay a few days in western New York, so it may be the 23rd or 24th before I can get to Grand Rapids.

Faithfully yours,
C. S. Sargent

LETTER 14

Grand Rapids, October 29, [1907]

Dear Miss Cole:

I am delighted to get your note and to hear of you in such good condition, and especially that you got no cold in those two stormy days. After I left you I went to St. Louis [MO] and stayed several days and then went into the southwestern part of the state where I had a successful time, although owing to late frosts the early-flowering species bore no fruit.

I am afraid it is too late to make any correction in proofs of the Michigan article. By the way, I have heard nothing of this article. Do you know any way by which I can find out about it? It seems to take a long time in Michigan to get anything printed.

I hope now to be able to complete the Grand Rapids' species this winter, thanks to the information we obtained while we were together. I have been so busy, however, with other matters since I got home that I have not begun yet the winter's work on *Crataegus*.

Always faithfully yours,
C. S. Sargent

LETTER 15

Grand Rapids, June 16, [1908]

Dear Miss Cole:

I am very much obliged for the package of *Crataegus* specimens which arrived yesterday. I am very glad to see that you are still interested in the genus and willing to help me with it. I hope sometime you will tell me about your experiences in Cuba and whether you did much botanizing there. What are your plans for the summer?

Faithfully yours,
C. S. Sargent

LETTER 16

July 13, [1908]

My dear Miss Cole:

The following is a list of your specimens which have not yet been determined or described:

Pruinosae.

181. This tree has been cut down but seeds have been sown. Do you think that this can be one of the described species?

171. Good specimens and notes.

142, 157. Good specimens and notes.

32-1. Good specimens and notes.

86, 44. “ “ “ “ [ditto marks]

75, 169. “ “ “ “ [ditto marks]

132, 158. Good specimens and notes.

Tenuifoliae.

124. This tree has been cut down but seeds have been sown.

1. Your specimens. [handwritten]

151. We could not find this last year. Seeds have been sown.

22. Seeds have been sown but there are no flowers and no notes.

36. No notes.

125. Seeds have been sown but there are no flowers.

15. Poor specimens. Seeds have been sown.

Molles.

153. No notes but good specimens. Can you furnish notes on habit, etc.? Seeds have been sown.

148, 134. Good specimens and notes.

Intricatae.

110, 25, 66, 106. New species, good material.

13. New species, good material.

178. New species. Flowers were collected too late to obtain the color of the anthers. I hope you will get this next spring.

Tomentosae.

174. New species ? Good material.

This shows that there is very little more for you to do about Grand Rapids in the *Crataegus* line unless you can find more species in some other locality. I daresay it would

not be necessary for you to go many miles away in order to find an entirely new set. If you can help with notes or any suggestions about the above numbers, I shall be very greatly obliged to you.

We are having here the hottest and driest summer I can remember. Everything is burnt up in New England and fires are raging all about. I am hoping to go to England on the 7th of August for a few weeks but shall be back in time for some *Crataegus* work this autumn.

With kind regards, I am,
Faithfully yours,
C. S. Sargent

APPENDIX 4. Letters from Charles Faye Wheeler (1842–1910), Instructor in Botany and Consulting Botanist, Experiment Station, Michigan Agricultural College, to Emma Cole (University of Michigan Herbarium Archives, photocopies provided to Julie Stivers by Dr. E. G. Voss on October 21, 2005; transcribed by Garrett Crow).



FIGURE 7. Charles Faye Wheeler, Botanist, Michigan Agriculture College (Photo ca. 1895; source: Michigan State University Archives and Historical Collections).

LETTER 1

Agricultural College, Ingham Co., Michigan December 5, 1893

Dear Friend.

The plants went yesterday. The *Malvastrum* and the *Astragalus* are new to me and I have not yet been able to find any descriptions of them in any books at hand. Will send the names as soon as I am able to find them. I will check the plants on the list and return it in a few days—

In regard to *Agrostis alba*, L. I will say that Botanists now do not consider 1. *A. alba*, L. 2. *A. stolonifera* L. 3. *A. vulgaris*, With. to be distinct sp[.], but forms of one variable Sp. The first form is common everywhere, the panicle may be white to deep purple, this ~~is~~ in Grays' Manual 6th Ed. = var. *vulgaris*. No. 2 is in the Manual *A. alba*, L. ~~grows~~ found in low grounds. The panicle is contracted after flowering, ligule long and acute. Not so common. No. 3 = No 1. There sometimes is found a very large form which is named var. *gigantea*, Koch.

Homer Skeels is a good student. We allowed him to enter in advance in botany. He ranked no. 1 in the final Examination.

Yours very truly
C. F. Wheeler

[Note: Homer Skeels was Emma Cole's student, Central High School Class of 1893, and had initially enrolled in Michigan Agricultural College as a special student in fall 1893, receiving his BS degree in 1898. For additional information on Skeels, see Crow (2017).]

LETTER 2

Agricultural College, Ingham Co., Michigan, October 9, 1897

Dear Friend.

I have looked a good deal but cannot yet find any reference to *Solea*. It would not be at all surprising to find cleistogamous flowers on *Solea* as they are so frequent in *Viola*. Then you may Congratulate yourself on having made an addition to our knowledge of the behavior of *Solea*. I at once went to the garden and interviewed our *Soleas* and sure enough there were plenty of nearly ripe fruits on the tops of the stems. The early flowers are axillary.

Now I want to disabuse your mind of any lingering suspicion even, that I have not time to answer any questions you may wish to send to me. Last vacation there was so much unusual work that fell to my lot that I did neglect all my correspondents, now this is not to happen again, if I can help it.

With kind regards to M. Fallass and family.
Yours sincerely
C. F. Wheeler.

[Note: Subsequent to Wheeler's letter responding to her question regarding cleistogamous flowers that never open, yet produce fruits with fertile seeds, which she observed occurring late in the season on plants of *Solea concolor* (now *Hybanthus concolor*, Green Violet), Emma Cole published a nice, but short, paper on that topic (Cole 1898).

VASCULAR FLORA AND PLANT COMMUNITY TYPES OF THE OTT BIOLOGICAL PRESERVE, CALHOUN COUNTY, MICHIGAN

Anna K. M. Bowen

Department of Biology, Miami University
700 E. High St.
Oxford, OH 45056
mille773@miamioh.edu

J. Dan Skean, Jr.

Department of Biology, Albion College
611 E. Porter St.
Albion, MI 49224-1831
dskean@albion.edu

ABSTRACT

The Harvey N. Ott Biological Preserve in Calhoun County, Michigan, comprises ca. 121 hectares (298 acres) of terrestrial plant communities that include oak-hickory forests, hardwood swamps, a prairie fen, and a highly disturbed remnant understory of former oak openings. This property, now owned by Calhoun County, was once owned by Albion College as its nature center. From September 2011 to November 2012, we conducted a floristic inventory of the area after having studied relevant herbarium specimens and an unpublished checklist of the area prepared by Dr. William Gilbert. Gilbert, who was a professor at Albion College, conducted an inventory of the vascular plants of the preserve from 1946 to 1954 and made 656 collections during this period. Based on current circumscriptions and names, Gilbert documented 460 different species, 63 (13.7%) of which were introduced, including 36 (7.8%) that are now considered invasive. We hypothesized that the percentages of introduced and invasive species of all taxa have increased since Gilbert's study. During our fieldwork, we documented 290 species that Gilbert collected that could easily be identified and made 292 collections of graminoids and other species that were either difficult to identify in the field or were not documented by Gilbert. Of these collections, 136 represent newly-recorded species for the preserve, which, when added to Gilbert's total, makes a total of 596 species recorded for the preserve. Of this total, 124 (20.8%) are introduced and 73 (12.2%) are considered invasive, which supports our hypothesis. Of the three currently state-listed rare plants that were documented by Gilbert, only two were relocated in 2012: *Geum virginianum* L. and *Amorpha canescens* Pursh, both listed as special concern. The third species, *Cypripedium candidum* Muhl. ex Willd. (listed as threatened), was not observed. A route for a portion of the North Country Trail through the preserve was finalized during this study. We hope that our work will provide useful baseline data for preserve management and stimulate more botanical studies of the area.

KEYWORDS: Vascular flora, floristic inventory, southern Michigan, plant communities, invasive species

INTRODUCTION

Encroachment by invasive species and habitat loss are two factors that affect native plant communities (Bossdorf et al. 2005; McCauley et al. 2013). To understand these effects, detailed inventories of biodiversity provide important

baseline data for assessing changes in species composition. Not only does biodiversity potentially relate to the stability of ecosystems (Tilman et al. 2006), natural communities can be used as reference systems in order to aid in restoration efforts (van Andel and Aronson 2012). Floristic studies of small areas that have been investigated over time may provide insights into how biodiversity has changed over a given time period (Judziewicz 2004).

Consisting of approximately 121 hectares (298 acres) located in Calhoun County, Michigan, the Harvey N. Ott Biological Preserve (hereafter referred to as the Ott Preserve, the Ott, or the preserve) is a nature preserve owned by the County, operated by the Calhoun County Board of Commissioners, and under the direction of the Calhoun County Parks and Recreation Commission (CCPRC) (Calhoun County, Michigan 2016b). It is composed of parts of sections 3, 4, 9, and 10 of Emmett Township (Gilbert 1954) in west central Calhoun County, north of East Michigan Avenue and west of North Wattles Road near Battle Creek (N42.31333°, W085.12173°).

The primary purpose of our study was to carry out a floristic inventory of the preserve and to compare it to an earlier inventory done by Dr. William J. Gilbert, who collected herbarium specimens during the years 1946–1954 and produced a vouchered checklist, which was never published. We hypothesized that the percentages of introduced and invasive species of all taxa have increased since Gilbert's inventory. Another purpose of our study was to identify and map the major terrestrial plant communities and the locations of any rare species. We hope that this study will provide baseline data that aid in preserve management and stimulate more botanical studies of the area.

Physical Description of the Area

The topography of the area in and around the Ott Preserve, including an esker than runs from the northeast to southwest corner of the preserve and three spring-fed kettle lakes—Hall Lake, Brigham Lake, and Dexter Lake, was likely shaped by glaciers (Gilbert 1954). The esker is transected by three drainage basins, leaving four segments that Gilbert (1954) named the Brigham, Central, Hall, and Blank eskers. Only a small portion of Dexter Lake, which was formerly known as Blanck Lake, lies within the Ott. The outlets of Dexter and Brigham Lakes feed into Hall Lake through small inlets, and there is also an outlet for Hall Lake (Gilbert 1954). Elevations range from ca. 242 m to 337 m (793 to 1,105 ft.) (USGS 1999).

The soils of the Ott Preserve are characterized as Houghton muck, Coloma loamy sand, or Boyer sandy loam (Tardy 1997; Soil Survey Staff n.d.). Swamp areas in the northwest, northeast, and central portions of the preserve near the lakes are classified as Houghton muck, which has a high level of organic content. These areas are generally saturated with water and have poor drainage (Soil Survey Staff n.d.). The submerged soil between Hall and Dexter Lakes is visibly lighter in color and is most likely rich in calcium, unlike the dark Houghton muck. Coloma loamy sand and Boyer sandy loam, respectively, characterize the upland forests and the southern hardwood swamp on the eastern side of the preserve (Soil Survey Staff n.d.). Coloma loamy sand is a yellowish-brown soil that

is excessively drained and has low organic soil content. Boyer sandy loam is a dark brown loam that is well drained and has moderately low organic matter content (Soil Survey Staff n.d.). Annual precipitation for Calhoun County ranges from 885.9 to 959.8 mm, while 30-year average annual minimum and maximum temperatures range from -7.5 to -8.1°C and 15.6 to 16.7°C , respectively (based on 30-year data from 1981 to 2010) (PRISM 2004).

History of the Ott Preserve

Dr. William Gilbert, who was a biology professor at Albion College and a vital proponent of the care and research of the Ott, wrote a history of the preserve (Gilbert 1954) that spanned the years from 1911 to 1954. His account describes how the property became a nature preserve and later Albion College's nature center. It also characterizes the general geological and biological aspects of the preserve.

In 1911, when the first land purchases of what is currently known as the Ott Biological Preserve were made by Edward H. Brigham, founder and first director of the Kingman Museum of Natural History and teacher in Battle Creek, and Jay R. Snyder, the major forested areas of the Ott were primarily back woodlots of adjacent farms. After that time, Edward H. Brigham and other members of the then-active Nature Club of Battle Creek worked with Dr. John Harvey Kellogg, superintendent of the Battle Creek Sanitarium, to have the land set aside as a nature preserve. However, this was not realized until 1926, when Kellogg purchased the land for Battle Creek College, where it was named The Battle Creek College Biological Preserve (Gilbert 1954). During the period between 1926 and 1938, a number of studies were made by students and faculty, including a preliminary topographical and biological survey (Grant 1927) and a survey of the spring flora (Overholt 1929). In addition, Kellogg dedicated the preserve to the State of Michigan as a State Game Refuge and Bird Sanctuary in 1926, which spurred the planting of trees on the property for migratory birds (Grant 1927). Other proposed efforts, such as the development of an ethnobotanical garden and a guide manual for the preserve, were never executed due to the economic collapse in 1929 that eventually closed Battle Creek College in 1938 (Gilbert 1954).

Dr. Arthur M. Chickering, a biology professor at Albion College, recognized the opportunity to supplement studies in the biology department with a natural area. He worked with Dr. Harvey N. Ott, an alumnus of Albion who graduated in 1889, and members of the Board of Trustees of Albion College, who provided the funds to purchase the preserve from Battle Creek College. In October 1946, the land was dedicated as the Harvey N. Ott Biological Preserve (Gilbert 1954). Once the land was acquired by Albion College, the faculty, largely from the biology department, led groups doing maintenance on trails, and both faculty and students began research projects. In addition to Dr. Gilbert's work, Kenneth Ballou (1949) surveyed the protozoa of the preserve's lakes while other students conducted limnology projects on Hall Lake. In addition, Maynard C. Bowers, Albion Class of 1956, who later became a biology professor at Northern Michigan University, mapped many of the preserve's vascular plant species on aerial photographs. Thus, by this time, the Ott had become an important field trip and re-

search site for Albion College. However, because it was about 20 miles from Albion, it was difficult to control dumping, off-road vehicles, and the occasional theft of firewood or a valuable timber tree (E. A. Stowell, personal communication).

Although early records are lacking, minutes in the Department of Biology document the first meeting of a newly-established advisory committee for the preserve in 1964 (Stowell 1964). With the advisory committee in place and Dr. Anthony Catana, the biology department's ecologist, appointed as the director of the preserve, the College was able to create concrete plans for the maintenance of the property. These plans included the purchase of a Volkswagen bus for transporting students, monitoring the property, and making improvements at the entrances, especially the east entrance from Wattles Road, which was graded and where a new parking lot was constructed (Catana 1964). Catana and the committee also gained publicity for the preserve as a recreational and educational area through presentations and newspaper articles (Catana 1966). The committee also noted a positive change in the usage of the land: more hikers and photographers were seen and fewer fires, less wood cutting, and soil removal were observed. In spring 1967, local scouts were scheduled to develop a small pine plantation near the west entrance at Brownlee Park (Catana 1966). There is a small conifer plantation today in this area among young hardwoods.

Catana authored what is perhaps the only scientific paper on the Ott published in an established journal (Catana 1967). His study sampled the forests quantitatively and, based on an examination of the original land survey made in 1826, characterized the pre-settlement vegetation as predominantly an oak savanna having few trees per acre. Catana described the "prairie-forest transition" as succession resulting from a cessation of fires in this region that led to the closed canopy oak-hickory forests at the preserve. Catana also noted that a decrease in the number of individuals of *Larix laricina* (tamarack) was likely still in process due to a dropping water table. In addition, forest fires were noted for a section of oak-hickory forest north of Hall Lake in 1963 and 1965, resulting in a lower shrub and herb frequency. Also noted was a sharp decrease in the density of *Ulmus americana* (American elm) in lowland areas due to Dutch elm disease and the rising importance of *Lindera benzoin* (spicebush) (Catana 1967). Around this time, Catana's research student, Marjorie Jackson, wrote a thesis on the non-forest vegetation of the preserve. She took 100-foot transects in 14 representative non-forest areas on the preserve and calculated relative dominance (percent intercept on line) and (from quadrat data) relative density and relative frequency in order to determine importance values of species along the transects (Jackson 1968). Based upon her transects, she recognized three different types of non-forest vegetation at the Ott Preserve: (1) upland communities dominated by *Poa pratensis* and *Andropogon virginicus* along the west boundary of the property in a more extensive area than the current non-forested area adjacent to today's Consumers Energy right-of-way, and also in an area east of Hall Lake that is now forested, (2) shrub communities dominated by *Spiraea alba* and *Urtica dioica*, located in three more or less equally-spaced patches from an area just south of the current Jameson Street parking lot near the northwest edge of the property, extending northeast to the northeast edge of the property near the old Wattles

Road access, and (3) poorly-drained communities dominated by *Eleocharis rostellata* and the species now known as *Dasiphora fruticosa* most extensively in the area between Hall and Dexter lakes and also on the east side of Hall Lake and the northeast and southeast edges of Brigham Lake. She concluded from previous data that the well-drained (upland) and poorly drained communities had remained similar for the last 40 years previous to her study, but that the shrub communities had recently developed from swamp or marsh type vegetation in the past 20 years due primarily to change in drainage patterns (Jackson 1968). In 1969 and the years following, the relationship between Albion College and the Ott Preserve began to change when sixty acres along the Kalamazoo River adjacent to campus were purchased by the College (McIntyre 1969). Dr. Gilbert recognized that “the greatest value of [the sixty acres] is its availability as a teaching facility” and that “it would be a gross error not to utilize the land as an academic program of Albion College” (Gilbert 1970). Considerations such as these forced administrators to reconsider the role of the Ott as Albion College’s nature center. While it was universally recognized that the Ott was an excellent natural area, reaching out to other possible stakeholders, such as Battle Creek Community College, began to be more seriously considered (Gilbert 1970). Members of the academic community all agreed that Albion College had an obligation to see that the Ott Preserve stay a natural area, whatever its fate (Gilbert 1970).

The year 1970 saw a decrease in use of the Ott by Albion College and an increase in use at the sixty acres adjacent to campus. During that year only one directed study on birds and two research projects on nutrient cycling in Brigham Lake were conducted at the Ott (Catana 1971). Catana (1971) noted there was an average of only 48 hours of student activity per semester at the Ott, compared to 498 hours at the sixty acres, which would later become the core of Albion College’s Whitehouse Nature Center.

In 1971, Albion College and the Calhoun County Parks and Recreation Commission (CCPRC) began to plan a lease of the Ott Preserve (Bishop 1971). The proposed ten-year, one-dollar lease would place the property under county jurisdiction and maintenance with strict development restrictions. The College and CCPRC would be considered co-tenants of the Ott, and the College reserved the right to designate research areas that would be closed to the public. In addition, the County would be granted the right of first refusal to purchase the property should the College decide to sell (Land Lease Agreement 1972). The CCPRC had intended to develop a park that included Dexter Lake as its major focal point and to lease the adjacent Ott property. The plan was to purchase the 15 acres that included Dexter Lake from its private landowner and to develop an access road from Michigan Avenue along the Consumers Power right-of-way. However, the asking price for the property (\$50,000) and the cost of grading the road (\$20,000) were deemed too expensive for Recreation Bond funding. The failure of the county to secure Dexter Lake, and the projected maintenance costs of the Ott, which would be added to the costs of developing Kimball Pines Park, resulted in the decision of the CCPRC not to sign the lease (Nagel 1972).

Looking to the Michigan Department of Natural Resources (DNR) for assistance in purchasing the property proved to be a worthwhile effort for the

CCPRC; the DNR, which administered funds through the state assistance program of the federal Land and Water Conservation Fund Act of 1965, agreed to provide 50% of the funds necessary to purchase the property (Horvath 1977, Brewer 2003). In the summer of 1977, the Calhoun County Board of Commissioners approved the final purchase of the Ott Preserve for \$56,000, \$28,000 of which was provided by the DNR, \$14,000 of which was donated by the Miller Foundation of Battle Creek, and \$14,000 of which came from the county's general fund. Albion College had wanted deed restrictions on the property to ensure that it was kept in its natural state, but none were included because they would have lowered the appraised value upon which the DNR grant was based. The appraised value grant considerations were pointed out by Dennis R. Adams from the DNR in a letter explaining that Section 6(f) of the Land and Water Conservation Fund Act required that the land would be used for public outdoor purposes in perpetuity (Adams 1976). The County approved the sale with a motion that gave the cost breakdown and stated that "the land [is] to remain in its natural state with the exception of paths" (Calhoun County Board of Commissioners 1977). Albion College was permitted to continue using the property for educational purposes (Reilly 1977).

The lack of deed restrictions on the Ott property would cause consternation for those who wanted the preserve to remain in its natural state. As early as 1980, an article in the *Albion Evening Recorder*, which was published on April 30, suggested that the county was considering harvesting timber from its parks in order to fund them (Rompf 1980). The next day, Bernard Lomas, then President of Albion College, wrote the following in a letter to Gordon Martin, Chair of the Board of Commissioners (Lomas 1980):

When we sold the Ott Preserve to the Calhoun County Parks Association, we had a gentleman's agreement that the College would still be able to use the facility from time to time for educational purposes in the field of biology and that it would be maintained in a natural state. The article indicated that consideration might be given to harvesting the timber and this, of course, would destroy the natural state as we understood it would be maintained.

His letter was successful at the time. However, in 1993, the Calhoun County Commissioners agreed to sell the lumber from 305 trees and to cull "56 trees of no value" for \$36,000, but to leave all tops and cull trees on site. Many large oaks and several cherries were taken from the mature forests near the end of Peck Street by Michigan Veneer & Hardwood Inc. (Parks 1993). Trees were marked for harvest in other areas of the Ott, but public outcry stopped further cutting (Basso 1994). Dr. Richard Brewer, a plant ecologist at Western Michigan University, visited the site with his ecology class after the logging, and they measured and counted stumps. Several were over 40 inches in diameter and some trees were more than 200 years old, the oldest being a white oak at 278 years. Brewer (2003) described the logging at the Ott Preserve in some detail and uses it as a case study of what can happen to a natural area when it changes ownership and protection is not assured.

The logging brought public attention and renewed interest in the Ott Preserve. Alex Sutarek, a California resident who owned 42 acres adjacent to the south part of the preserve, donated his land (referred to as the Sutarek tract) to the

County to be added to the preserve, a gift that put Hall Lake completely within the preserve. The County dedicated all funds obtained from the logging to the Ott and appointed an advisory committee, which became a non-profit group in 1995 called Friends of the Ott Preserve (FOTOP). FOTOP received grants from the Consumers Power Foundation (now called Consumers Energy Foundation) and The Albert L. and Louise B. Miller Foundation (now The Miller Foundation), which were used for signage and trail improvements, including a boardwalk that extended into the central swamp (Anonymous 1995; Friends of the Ott Preserve 1996, 1997). In 2000, the County received a major grant from the Michigan DNR for \$231,962, which was used to construct an Arlington Street parking lot at the south end of the property, a Jameson Street parking lot at the north end of the property, better trails, and a handicapped-accessible boardwalk completely traversing the central swamp. It also paid for an historic bridge spanning the Brigham Lake outlet, new signs, a boundary survey, fencing, clean-ups, brochures, and bird houses (Annette Chapman, personal communication).

In recent years, there has been an additional environmental controversy at the Ott Preserve about constructing a paved trail through the preserve and the placement of the trail. The Calhoun County Road Commission received a grant for \$1,075,591.70 from the Michigan Department of Transportation for the development of a walking and bicycle trail through the Ott Preserve that is part of the North Country Trail (Garnett and Coury 2010). The proposed trail was to be approximately ten feet wide, with two-foot shoulders on each side, and would have either a blacktop or a crushed lime surface. Heavy equipment would be used to do the grading, and in some cases deep cuts into banks would be made. There were discussions about routes and eventually a trail with a crushed lime surface was chosen. The first author presented the results of the current study to members of the Calhoun County Trailway Alliance (CCTA) on September 28, 2012 and, shortly thereafter, both authors walked the proposed route with members of the CCTA, who considered our suggestions. The chosen route connects the Jameson Street and Arlington Street parking areas, and its south portion skirts the east edge of the preserve. The trail was completed in October 2014 and a small ribbon-cutting ceremony, which was attended by the second author, was held on November 21, 2014. The Calhoun County Board of Commissioners approved the 2015-2019 *Calhoun County Parks and Recreation Master Plan*, which included the Ott (Calhoun County Community Development 2015) on February 5, 2015 (Calhoun County Board of Commissioners 2015a). A grand opening and dedication for the county's new segment of the North Country Trail was held at nearby Kimball Pines Park on June 6, 2015 (Calhoun County Board of Commissioners 2015b).

In 2015, the County established an Ott Biological Preserve Work Group, which drafted a maintenance and management plan. A public hearing on the draft plan was held on October 13, 2016 (Calhoun County, Michigan 2016a), and the final 81-page *Ott Biological Preserve Management and Maintenance Plan* (Calhoun County, Michigan 2016b) was presented to the Board of Commissioners on March 16, 2017 (Calhoun County Board of Commissioners 2017). There is optimism that the Ott will become a more popular park that is actively managed to maintain biodiversity.

METHODS AND MATERIALS

Gilbert's manuscript list of 460 vascular plant taxa that he collected at the preserve was compiled and updated with current names from Michigan Flora Online (2011) and Voss and Reznicek (2012). Meander surveys in different representative areas of the preserve were conducted weekly from September 2011 to October 2012 during the growing seasons. A few additional collections were made by the second author and students through September 2018. The survey primarily verified species occurrences using Gilbert's list and herbarium specimens at the Albion College Herbarium (ALBC). New specimens were collected for those species that were either difficult to identify in the field (e.g., graminoids) or those not present on Gilbert's list. All species reported here are vouchered by herbarium specimens at ALBC. The Gilbert collections were annotated by Edward G. Voss in preparation for the *Michigan Flora* (Voss 1972, 1985, 1996). About 43 specimens of Cyperaceae, Poaceae, and some county records for which there were duplicates, are deposited at the University of Michigan Herbarium (MICH). The relative abundance of each documented taxon was noted qualitatively as follows: rare (few individuals in a small area), uncommon (few individuals in a few clusters), occasional (few individuals in many clusters), locally common (many individuals in few clusters), and common (many individuals throughout the community in many clusters). GPS coordinates were recorded for all recent collections. The majority of the surveys were done near trails, although each community was transected in different representative areas in order to maximize encounters with different species. The classification systems for natural communities by Kost et al. (2007) and Cohen et al. (2014) were used to identify and classify the terrestrial natural communities present at the Ott preserve. A map of the major natural community types was made using ArcGIS: ArcMap v. 10.6.1 (ESRI 2018).

Floristic Quality Assessments (FQAs) were conducted for the prairie fen and the oak opening natural communities to assess their floristic and natural significance (Herman et al. 2001) and to assess how the floristic quality of these areas has changed over time. Species are assigned a coefficient of conservatism (C), which indicate the tolerance to degradation and the degree to which a species is faithful to pre-European settlement conditions (Herman et al. 2001, Freyman et al. 2016). A species assigned a C value of "0," therefore, may be found nearly everywhere, whereas species assigned a C value of "10" are almost always restricted to a pre-settlement remnant (a high-quality area). For example, *Carex alata*, the winged sedge, is restricted to bogs, sedge meadows, and fens and is assigned a C value of 10 (Reznicek et al. 2014). A high C value does not necessarily indicate rarity, although many rare plants are assigned high C values. FQAs are created by calculating a mean coefficient of conservatism (\bar{C}) and a Floristic Quality Index (FQI) from a list of plants at each site. The FQI is calculated by multiplying \bar{C} by the square root of the total number of native taxa ($FQI = \bar{C}\sqrt{n}$) (Herman et al. 2001, Freyman et al. 2016). In this case, an FQI was calculated for each community separately for species documented by Gilbert and for those recently documented by us. The C values were taken from Michigan Flora Online (2011). For each FQI, we calculated Native richness, Total richness, Native \bar{C} , Total \bar{C} , Native FQI, and Adjusted FQI, the latter of which includes the contribution of non-native species (Freyman et al. 2011).

The numbers and percentages of introduced and invasive species present for both Gilbert's checklist and our updated checklist, which includes Gilbert's documented species as well as our new additions, were documented. Percentage values for Gilbert's checklist were calculated by dividing the number of introduced or invasive species by the total number of species that he documented. For percentage values for our updated checklist, we divided the species that were documented during this study by all species found at the Ott preserve, including those that Gilbert collected that we did not find. The designation of species as invasive follows the Midwest Invasive Species Information Network (Michigan State University 2018). None of the species collected or observed by us only on the Sutarek tract, which was added to the preserve after Gilbert's study, was used in percentage calculations of new invasives or additional species not collected by Gilbert.

GPS coordinates of populations of state-listed rare plants (Michigan Natural Features Inventory 2009) were recorded and used to make maps in ArcGIS. For larger populations, the coordinates of only the peripheral individuals were recorded. Two species on our checklist (*Brickellia eupatorioides* and *Conioselinum chinense*) were designated as Special Concern after the conclusion of our study and were thus not mapped.

RESULTS

A total of 292 specimens was collected at the preserve for this study. Of those specimens, 136 represented newly recorded species for the preserve that were not collected by Gilbert. Gilbert’s 460 species and the 136 new species collections make a grand total of 596 vascular plant species, including varieties, forms and subspecies, that have been documented at the Ott Preserve (Tables 1 and 2). The five families with the largest number of species are Asteraceae (65), Poaceae (47), Fabaceae (37), Cyperaceae (34), and Rosaceae (34). Sixty-five of the species documented in this study are new records for Calhoun County, according to maps in Michigan Flora Online (2011). Two hundred and ninety of the species collected by Gilbert were observed and noted. 170 species collected by Gilbert were not collected or noted by the authors. A complete annotated checklist of the vascular plants now known to occur or to have occurred in the Ott Preserve is presented in Appendix 1. The major plant communities of the Ott are dry-mesic southern forest, southern hardwood swamp, oak openings understory, and prairie fen (Figure 1).

Native and Total species richness increased between Gilbert and our study

TABLE 1. Summary of Gilbert’s vascular plant collections from the Ott Preserve, 1946–54. The totals for species are summed for native and introduced species.

Taxonomic group	Families	Genera	Species			Total
			Native	Introduced	Invasive	
Lycophytes	2	2	2	0	0	2
Ferns	10	13	15	0	0	15
Conifers	2	3	4	0	0	4
Angiosperms	88	268	376	63	36	439
Total	102	286	397	63	36	460
Percentage of Total Species			86.3%	13.7%	7.8%	

TABLE 2. Summary of all vascular plants collected from the Ott Preserve, 1946–2016. The total numbers of species are summed separately for native and for introduced species. The numbers for invasive species do not include those species found only on the Sutarek tract (these species are included, however, in Appendix 1 and in Table 3).

Taxonomic group	Families	Genera	Species			Total
			Native	Introduced	Invasive	
Lycophytes	2	2	2	0	0	2
Ferns	11	14	17	0	0	17
Conifers	3	5	6	2	1	8
Angiosperms	98	312	447	122	72	569
Total	114	333	472	124	73	596
Percentage of Total Species			79.2%	20.8%	12.2%	

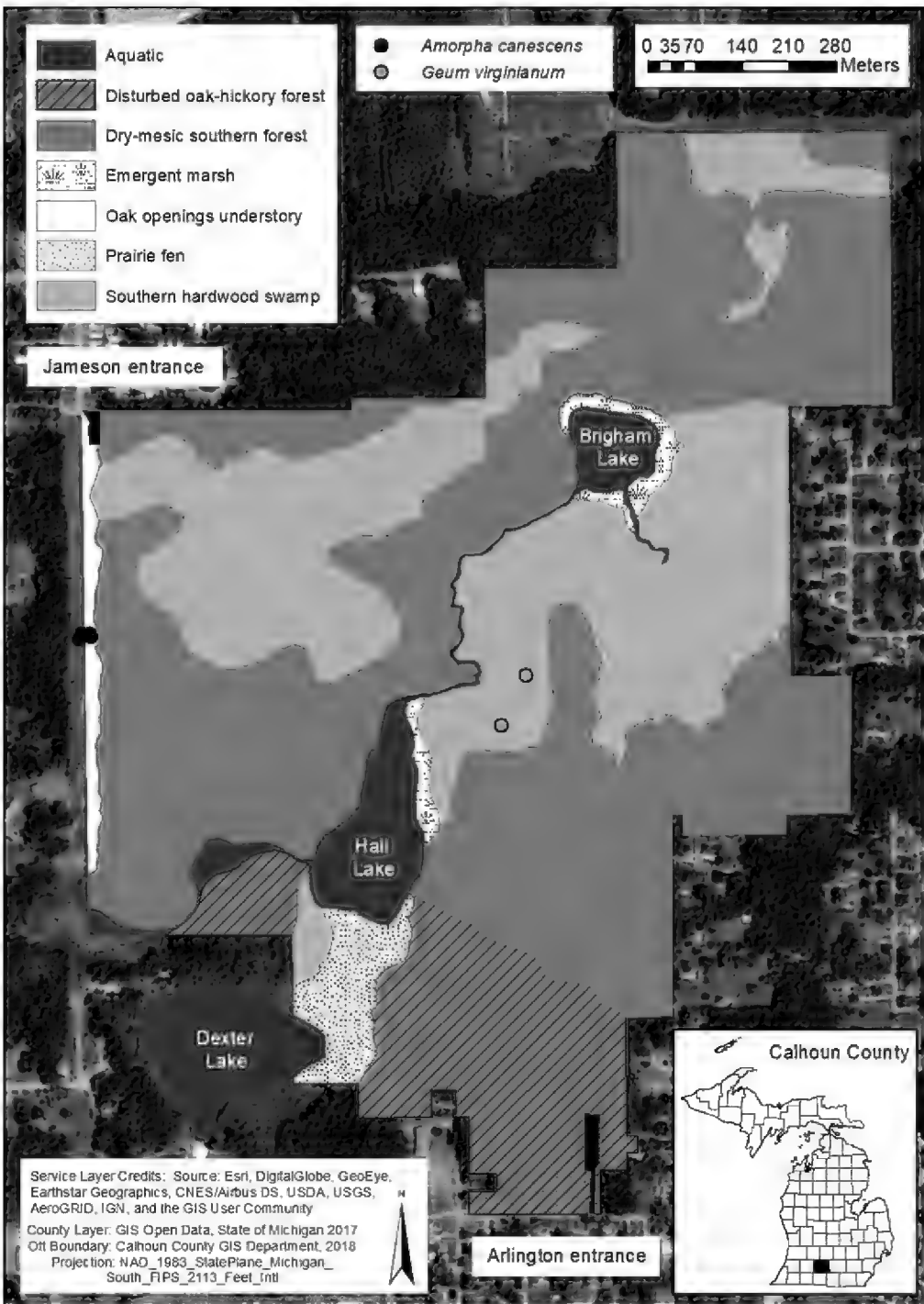


FIGURE 1. Major terrestrial plant communities and locations of state-listed rare plants at the Ott Preserve: *Geum virginianum* (pale avens) population in the southern hardwood swamp (grey dots near center of map) and *Amorpha canescens* population on the Consumers Energy power line right-of-way remnant oak opening understory (black dots on left side of map).

according to the Floristic Quality Assessment (FQA) for the oak opening understory (Table 4). Native mean *C* was 4 for both studies, while Total mean *C* decreased from 2.8 to 2.3. Native FQI increased from 31.7 to 34.2, while Adjusted FQI decreased from 33.1 to 30.6.

For the prairie fen, Native richness declined from 76 to 73 while total richness increased from 80 to 81 between Gilbert’s and our study (Table 4). Native and Total mean *C* both declined over time, from 6 to 5.9 and 5.7 to 5.3, respectively. Similarly, Native FQI decreased between studies from 52.3 to 50.4 and Total FQI decreased from 58.5 to 56.0.

Populations of the state-listed plants, *Amorpha canescens* (lead-plant) and *Geum virginianum* (pale avens), were found in 2012. The locations of these populations are shown in Figure 1. *Cypripedium candidum* (the white lady-slipper) was not found during this study, despite extensive searches around the Hall Lake prairie fen. This species was last seen on the prairie fen by the second author in ca. 2001. *Brickellia eupatorioides* and *Conioselinum chinense*, both designated as Special Concern after the conclusion of our study, were also documented in 2012. *Brickellia eupatorioides* was documented in the disturbed oak-hickory forest, while *C. chinense* was documented near the outlet stream of Brigham Lake.

The proportions of both introduced species and of invasive species increased over time. Of the 460 species collected by Gilbert, 63 (13.7%) were introduced and 36 (7.8%) were invasive. Of the 596 species reported from the Ott Preserve following our study, the number of introduced species almost doubled, increasing to 124 species (20.8%). The number of invasive species increased to 73 (12.2%). A full checklist of invasive species, their locations, and their relative abundances is presented in Table 3.

TABLE 3. Invasive species (Midwest Invasive Species Network 2018) and their respective locations and abundances. DMSF = Dry-mesic southern forest. SHS = Southern hardwood swamp.

Species	Common name	Location	Abundance
<i>Acer platanoides</i>	Norway maple	Sutarek property	Common
<i>Agrostis gigantea</i>	Redtop	Prairie fen E of Hall Lake	Occasional
<i>Ailanthus altissima</i>	Tree-of-heaven	DMSF, Sutarek tract, logging deck area	Locally common
<i>Alliaria petiolata</i>	Garlic mustard	DMSF, Sutarek tract	Common
<i>Ambrosia artemisiifolia</i>	Common ragweed	Dry mesic prairie	Occasional
<i>Barbarea vulgaris</i>	Yellow rocket	Wet soil near eskers	Occasional
<i>Berberis thunbergii</i>	Japanese barberry	SHS	Occasional to locally common
<i>Berteroa incana</i>	Hoary alyssum	Oak opening understory	Common
<i>Bromus inermis</i>	Smooth brome	Oak opening understory and near Arlington entrance	Common
<i>Bromus tectorum</i>	Downy chess	Oak opening understory	Common
<i>Centaurea diffusa</i>	Brown knapweed	Border of E Hall Lake	No recent observation
<i>Centaurea stoebe</i>	Spotted knapweed	Oak opening understory	Common
<i>Celastrus orbiculatus</i>	Oriental bittersweet	Sutarek tract, DMSF	Locally common
<i>Cirsium vulgare</i>	Bull thistle	Along roadside on sandy hillside	No recent observation
<i>Convolvulus arvensis</i>	Field bindweed	SE arm of preserve	No recent observation
<i>Conyza canadensis</i>	Horseweed	Oak opening understory	Common
<i>Dactylis glomerata</i>	Orchard grass	Oak opening understory	Common
<i>Daucus carota</i>	Queen-Anne’s-lace	Oak opening understory	Occasional
<i>Dianthus armeria</i>	Deptford pink	Oak opening understory	Common

TABLE 3. Continued.

Species	Common name	Location	Abundance
<i>Dipsacus fullonum</i>	Wild teasel	Oak opening understory	Uncommon
<i>Elaeagnus umbellata</i>	Autumn-olive	Oak opening understory	Occasional
<i>Epilobium hirsutum</i>	Great hairy willow-herb	Dried swamp on N side of property	Occasional
<i>Euonymus alatus</i>	Winged euonymus	NW DMSF	Locally common
<i>Euonymus fortunei</i>	Wintercreeper	Sutarek property	Occasional
<i>Euphorbia cyparissias</i>	Cypress spurge	Near Jameson parking lot	Locally common
<i>Hedera helix</i>	English ivy	Northern DMSF	Locally common
<i>Hemerocallis fulva</i>	Orange day-lily	NW DMSF	Locally common
<i>Hesperis matronalis</i>	Dame's rocket	Sutarek tract, S DMSF	Common
<i>Hieracium aurantiacum</i>	Orange hawkweed	Northern DMSF	Occasional
<i>Hieracium caespitosum</i>	Yellow hawkweed	Oak opening understory	Occasional
<i>Hypericum perforatum</i>	Klamath weed	Prairie fen	Common
<i>Fallopia japonica</i>	Japanese knotweed	Sutarek property	Locally common
<i>Frangula alnus</i>	Glossy buckthorn	Prairie fen and around Hall and Brigham Lakes	Common
<i>Lathyrus latifolius</i>	Sweet pea	DMSF near prarie	Rare
<i>Leonurus cardiaca</i>	Motherwort	NW DMSF	Occasional
<i>Leucanthemum vulgare</i>	Ox-eye daisy	Dry mesic prarie	Occasional
<i>Lonicera × bella</i>	Hybrid honeysuckle	Sutarek tract	Occasional
<i>Lonicera morrowii</i>	Morrow honeysuckle	Sutarek tract	Occasional
<i>Lotus corniculatus</i>	Birdfoot trefoil	Oak opening understory	Locally common
<i>Lythrum salicaria</i>	Purple loosestrife	SHS near Brigham boardwalk	Locally common
<i>Melilotus albus</i>	White sweet-clover	Oak opening understory	Common
<i>Melilotus officinalis</i>	Yellow sweet-clover	Oak opening understory	Common
<i>Morus alba</i>	White mulberry	Sutarek property	Occasional
<i>Nasturtium officinale</i>	Watercress	SW of Hall lake	No recent observation
<i>Phalaris arundinacea</i>	Reed canary grass	North swamp	Occasional
<i>Phleum pratense</i>	Timothy	Dry mesic prarie	Occasional
<i>Phragmites australis</i> subsp. <i>australis</i>	Reed	E edge of Brigham Lake, and at bridge	Locally common
<i>Pinus sylvestris</i>	Scots pine	Border of Dry mesic prairie	Uncommon
<i>Poa compressa</i>	Canada bluegrass	Along road of Brownlee park entrance	No recent observation
<i>Poa nemoralis</i>	Bluegrass	DMSF	Occasional
<i>Poa pratensis</i>	Kentucky bluegrass	Oak opening understory and sandy area E of Hall Lake	Common
<i>Potentilla recta</i>	Rough-fruited cinquefoil	Near Jameson parking lot	Locally common
<i>Ranunculus acris</i>	Common buttercup	NE entrance from Wattles Rd.	No recent observation

(Continued on next page)

TABLE 3. Continued.

Species	Common name	Location	Abundance
<i>Rhamnus cathartica</i>	Common buckthorn	DMSF, Sutarek tract, Brigham Lake area	Locally common to common
<i>Robinia pseudoacacia</i>	Black locust	Dry-mesic southern forest	Occasional
<i>Rosa multiflora</i>	Multiflora rose	SHS, Boggy area near bridge	Locally common
<i>Rumex acetosella</i>	Red sorrel	Oak opening understory	Locally common
<i>Rumex crispus</i>	Sour dock	Near Jameson entrance	Locally common
<i>Rumex obtusifolius</i>	Bitter dock	Near Hall Lake and SE corner of preserve	No recent observation
<i>Saponaria officinalis</i>	Bouncing bet	Oak opening understory and near Arlington parking lot	Uncommon
<i>Securigera varia</i>	Crown-vetch	Near Arlington parking lot	Locally common
<i>Silene latifolia</i>	White cockle	Oak opening understory	Common
<i>Silene vulgaris</i>	Bladder campion	Oak opening understory	Occasional
<i>Solanum carolinense</i>	Horse-nettle	Grassy pasture SE and W border of preserve	No recent observation
<i>Solanum dulcamara</i>	European bittersweet	Near Arlington entrance and edge of Brigham lake	Common
<i>Stellaria media</i>	Common chickweed	Near Arlington entrance	Locally common
<i>Torilis japonica</i>	Hedge-parsley	Oak opening understory	Occasional
<i>Toxicodendron radicans</i>	Poison-ivy	DMSF	Common
<i>Trifolium arvense</i>	Rabbitfoot clover	Dry mesic prairie	Locally common
<i>Trifolium pratense</i>	Red clover	Near Arlington and Jameson entrances	Common
<i>Trifolium repens</i>	White clover	Near Arlington and Jameson entrances	Common
<i>Typha angustifolia</i>	Narrow-leaved cat-tail	Margins of lakes	Locally common
<i>Ulmus pumila</i>	Siberian elm	Sutarek property	Common
<i>Verbascum thapsus</i>	Flannel plant	Near Arlington entrance and Oak opening understory	Occasional
<i>Vincetoxicum nigrum</i>	Black swallow-wort	Oak opening understory	Occasional

TABLE 4. Floristic Quality Assessment results for the Oak openings understory and the Prairie fen communities. Assessments were performed separately for (i) those species collected by Gilbert only (the columns entitled “Gilbert”) and for (ii) all the species documented in the present study, including those collected by Gilbert as well as those later documented by Miller (Bowen) and Skean (the columns entitled “Miller”).

	Oak openings understory		Prairie fen	
	Gilbert	Miller	Gilbert	Miller
Native richness	63	73	76	73
Total richness	92	125	80	81
Native \bar{C}	4	4	6	5.9
Total \bar{C}	2.8	2.3	5.7	5.3
Native FQI	31.7	34.2	52.3	50.4
Adjusted FQI	33.1	30.6	58.5	56.0

DISCUSSION

Natural Community Types

For a property predominately surrounded by residential areas, the Ott Preserve hosts a wide variety of natural community types. The four terrestrial community types present were surveyed extensively and together comprise nearly the entirety of the property.

Dry-mesic southern forest

Ranked as S3 (vulnerable at the state level), this community type is an oak-hickory forest found on sandy loam (Lee 2007) along the esker throughout the property, as well as on the northern side. In Michigan, dry-mesic southern forests are found south of the climatic tension zone in southern lower Michigan (Lee 2007). Historically, frequent, low-intensity surface fires allowed for tree regeneration (Cohen et al. 2014) and perhaps kept pathogens at low levels (Lee 2007).

In this community at the Ott, common trees include *Acer rubrum* (red maple), *Fagus grandifolia* (American beech), *Prunus serotina* (black cherry), *Quercus velutina* (black oak), *Q. alba* (white oak), *Q. rubra* (red oak), and *Sassafras albidum* (sassafras). Common understory species are *Cornus alternifolia* (alternate-leaved dogwood), *C. florida* (flowering dogwood), and *Viburnum acerifolium* (maple-leaved viburnum).

Showy wildflowers are not abundant, but *Anemone quinquefolia* (wood anemone), *Geranium maculatum* (wild geranium), *Geum canadense* (white avens), *Maianthemum canadense* (wild lily-of-the-valley), *Podophyllum peltatum* (mayapple), and *Solidago caesia* (bluestem goldenrod) are frequently encountered. Numerous species of *Carex* are occasional to common, including *C. blanda*, *C. cephalophora*, and *C. gracillima*. Some grasses are occasional, including *Agrostis perennans* (autumn bent), *Bromus pubescens* (Canada brome), *Dichanthelium latifolium* (broad-leaved panic grass), and *Festuca subverticillata* (nodding fescue). *Asplenium platyneuron* (ebony spleenwort) and *Pteridium aquilinum* (bracken fern) appear to be the most common ferns.

Introduced and invasive species have become established in this community, especially along trails in the Sutarek tract near the Arlington Street parking lot. This area was previously an apple orchard and at one time was platted for residential development. It is likely that residential area activity, such as cultivation, construction, and dumping promoted the establishment of these introduced species. The overstory trees of the Sutarek tract include box-elder (*Acer negundo*) and the invasives *Ulmus pumila* (Siberian elm), *Robinia pseudoacacia* (black locust) and *Ailanthus altissima* (tree-of-heaven). Notable invasives include *Alliaria petiolata* (garlic mustard) and *Celastrus orbiculatus* (oriental bittersweet), the latter a vine so well established at the southwest corner of the property, next to Dexter Lake, that it covers almost all the area from the trees to the ground. Another common invasive becoming established along trails in the Sutarek tract is *Fallopia japonica* (Japanese knotweed). *Euonymus alatus* (winged euonymus) is conspicuous on the northeast side of the preserve. The major deck area of the 1994 logging, which is near the Sutarek tract, includes an

abundance of *Ailanthus altissima* (tree-of-heaven) and *Robinia pseudoacacia* (black locust). Other introduced and planted species include *Hemerocallis fulva* (orange day-lily) and *Pinus sylvestris* (Scots pine). *Celastrus orbiculatus* (oriental bittersweet) is also a very problematic invasive in this community east of Dexter Lake and near the east entrance from Wattles Road, which is currently being used as a personal driveway. However, a species (*Brickellia eupatorioides*, False boneset) recently designated as Special Concern was documented in this disturbed community near the Arlington parking lot.

Southern hardwood swamp

On both sides of sloping eskers near the center of the property lie the southern hardwood swamp community. It is ranked as S3 (vulnerable at the state level) (Slaughter 2009). This community type occurs in southern Lower Michigan on mineral or organic soils in shallow, poorly drained depressions (Slaughter 2009). The microtopography, woody debris, and drainage provide a diversity of habitat establishment sites for plant species (Slaughter 2009).

Dominant trees in the hardwood swamp at the Ott include *Betula alleghaniensis* (yellow birch), *Carpinus caroliniana* (hornbeam), *Fraxinus nigra* (black ash), *F. pennsylvanica* (green ash), and *Tilia americana* (basswood). *Lindera benzoin* (spicebush) is a common understory shrub. Common forbs include *Arisaema triphyllum* (Jack-in-the-pulpit), *Aquilegia canadensis* (wild columbine), *Caltha palustris* (marsh marigold), *Circaea canadensis* (enchanter's-nightshade), *Gallium tinctorium* (stiff bedstraw), *Hackelia virginiana* (beggar's lice), and *Impatiens capensis* (spotted touch-me-not).

Ferns are quite common throughout this community; noteworthy species include *Athyrium filix-femina* (lady fern), *Dryopteris carthusiana* (spinulose woodfern), *Osmundastrum cinnamomeum* (cinnamon fern), and *Osmunda regalis* (royal fern). In addition, there are occasional patches of the lycophyte, *Huperzia lucidula* (shining clubmoss). *Geum virginianum* (the pale avens) is a state-listed species in Michigan with the status of special concern. We collected it in the swamp northeast of Hall Lake (Figure 1). In 1950, Gilbert collected this species "on sloping sides of Brigham esker." Aside from *Berberis thunbergii* (Japanese barberry), only the invasives *Lythrum salicaria* (Purple loosestrife) and *Solanum dulcamara* (European bittersweet) have become established in the swamp.

Oak openings (remnant understory)

One of the most noteworthy communities present, because of its local rarity and abundance of prairie species, occurs in the Consumers Energy power line right-of-way on the west side of the property to the south of the Jameson Street parking lot at the northeast corner of the preserve. This area is likely remnant understory of oak openings (Cohen et al. 2014) and corresponds to mixed oak savanna from ca. 1800 that Comer et al. (1995) described based on General Land Office survey notes. The area consists of a prairie-like community along the power line right-of-way that has remained open likely due to woody species management, and a neighboring oak forest of which a significant portion was described as open by Gilbert (1954). This community, therefore, does not fit the

characteristic structure of an oak openings remnant with widely spaced trees (Cohen 2004). See Chapman and Brewer (2008) for a review and classification of prairies and savannas in southern lower Michigan. Oak openings are ranked as S1 (critically imperiled at the state level) due to widespread fire suppression and conversion to agriculture, pasture, and development (Curtis 1959; Chapman 1984; Cohen 2004). In Michigan there are only two currently known occurrences of oak openings, in Barry and Ionia counties, but Cohen (2004) notes that degraded remnants may exist within the historical range south of the climatic tension zone. General Land Office surveys note that a high concentration of this community type occurred in Calhoun County, with 20% of the state occupied by oak openings (Cohen 2004).

Historically, low-intensity fire played a critical role in maintaining the open canopy conditions of oak openings (Curtis 1959; Cohen 2004). In this community type, fire maintains forb and graminoid diversity and stimulates seed germination and flowering while deterring woody vegetation (Tester 1989; Cohen 2004). In the absence of frequent fires, forb diversity declines and woody species encroach, which ultimately allows a closed canopy community to form (Curtis 1959, Cohen 2004)

Encroachment has already begun at the Ott Preserve, as woody vegetation such as *Cornus foemina* (gray dogwood), *Corylus americana* (hazelnut), *Quercus velutina* (black oak), *Sambucus canadensis* (elderberry), and as the invasive *Elaeagnus umbellata* (autumn-olive) are beginning to form thickets throughout the area. However, many oak openings/prairie plants continue to thrive in this dry, sandy habitat. Noteworthy and common plants present include *Asclepias amplexicaulis* (clasping milkweed), *Asclepias tuberosa* (butterfly weed), *Carex pensylvanica* (sedge), *Desmodium* spp. (tick-trefoil), *Dichanthelium* spp. (panic grass), *Liatris aspera* (rough blazing-star), *Lithospermum caroliniense* (hairy puccoon), *Panicum virgatum* (switch grass), *Penstemon hirsutus* (hairy beard-tongue), *Rosa carolina* (pasture rose), *Rudbeckia hirta* (black-eyed susan), *Schizachyrium scoparium* (little bluestem), *Tradescantia ohiensis* (spiderwort), and *Tridens flavus* (purpletop). *Amorpha canescens* (lead-plant), a state-listed special concern shrub, was rare in this area.

In addition to encroachment by woody species, many introduced species—mostly grasses—have become established in the oak openings understory. Species such as *Arrhenatherum elatius* (tall oatgrass), *Bromus inermis* (smooth brome), *B. japonicus* (Japanese brome), *B. tectorum* (cheat grass), *Dactylis glomerata* (orchard grass), *Festuca trachyphylla* (sheep fescue), and *Poa pratensis* (Kentucky bluegrass) are common. Invasive forbs, including *Centaurea stoebe* (spotted knapweed), *Dianthus armeria* (Deptford pink), *Melilotus albus* (white sweet-clover), and *M. officinalis* (yellow sweet-clover) are very common in this area of the preserve. The invasive, *Vincetoxicum nigrum* (black swallow-wort), is locally common and is a potential cause for concern in this community.

Prairie fen

Located in the areas adjacent to Hall and Dexter Lake on the SW side of the property, the prairie fen is an interesting community type indigenous to the Ott Preserve due to the presence of carnivorous plants and orchids. It is a wetland com-

munity restricted in Michigan to the southern part of the lower Peninsula that is characterized by sedges, grasses, and calcareous soil on poorly drained outwash channels (Spieles et al. 1999; Cohen et al. 2014). The soil is composed of saturated organic deposits and marl, a calcium carbonate (CaCO_3) precipitate. This community type is ranked as S3 (vulnerable at the state level) (Spieles et al. 1999).

Prairie fens are home to a range of species, including a large number of sedges. Common native species found in 2011 and 2012 by the authors include *Bromus ciliatus* (fringed brome), *Eleocharis erythropoda* and *E. rostellata* (spike rushes), *Juncus dudleyi* (dudley's rush), *Larix laricina* (larch), *Lobelia kalmii* (Kalm's lobelia), *Lysimachia quadiflora* (whorled loosestrife), *Panicum flexile* (panic grass), *Sarracenia purpurea* (pitcher-plant), *Schoenoplectus acutus* (hard-stem bulrush), *S. tabernaemontani* (softstem bulrush), *Scutellaria galericulata* (marsh skullcap), *Selaginella eclipses* (selaginella), numerous *Solidago* species (goldenrods), *Toxicodendron vernix* (poison sumac), *Utricularia* spp. (bladderworts), and numerous *Carex* species, including *C. alata*, *C. comosa*, *C. hystericina*, and *C. stricta* (sedges).

Some of the more uncommon and noteworthy species are *Bidens trichosperma* (tickseed-sunflower), *Campanula aparinoides* (marsh bellflower), *Gentianopsis virgata* (small fringed gentian), *Liatris spicata* (marsh blazing-star), *Scleria verticillata* (nut-rush), *Iris virginica* (southern blue flag), and the orchids *Calopogon tuberosus* (grass-pink), and *Pogonia ophioglossoides* (rose pogonia). The introduced invasive *Frangula alnus* (glossy buckthorn) has become well established, making large thickets in all areas near the edge of the fen alongside the poison sumac. In addition, the introduced species *Typha angustifolia* (narrow-leaved cat-tail) and likely its hybrids with the native *T. latifolia* (common cat-tail), which is known as *T. ×glaucia* Godr., is becoming established on the south side of Hall Lake, as it is elsewhere in southern Michigan (Huisman et al. 2012).

Emergent marsh

The area surrounding Brigham Lake is a small emergent marsh that hosts a variety of vascular plants not common in other parts of the preserve. Notable species include *Carex blanda*, *C. hystericina*, *C. leptalea*, *C. tribuloides*, *C. rosea* (sedges), *Cyperus strigosus* (long scaled nut sedge), *Eleocharis rostellata* (spike-rush), *Calamagrostis stricta* subsp. *inexpansa* (narrow-leaved reedgrass), *Galium trifidum* (small bedstraw), *Mimulus ringens* (monkey-flower), *Persicaria amphibia* var. *emersa* (water smartweed), *Pogonia ophioglossoides* (rose pogonia), *Scirpus atrovirens* (bulrush), *Thelypteris palustris* (marsh fern), and *Conioselinum chinense* (Hemlock-parsley) (Special Concern). A few invasive species have encroached in the area, such as *Phalaris arundinacea* (reed canary grass), *Phragmites australis* subsp. *australis* (reed), *Frangula alnus* (glossy buckthorn), *Rosa multiflora* (multiflora rose), *Solanum dulcamara* (European bittersweet), and *Typha ×glaucia* (hybrid cat-tail), the latter established in a large stand on the southeast side of Brigham Lake.

Floristic Quality Assessment

Our Floristic Quality Assessments suggest that the oak openings understory and prairie fen communities have retained their floristic quality since the time of

Gilbert's floristic inventory. Native richness has either increased or stayed the same in both communities, while total richness has increased in both communities. In addition, Native mean *C* values have remained essentially the same, while Total mean *C* values have decreased slightly over time. Native FQI values, which directly assess the floristic value of an area, indicate that these two communities have retained species conservative to these community types, as values for the oak openings understory actually increased over time while the prairie fen decreased slightly. The presence of new non-native species, which are included in the Adjusted FQI, shows a slight decrease in floristic value over time.

The oak openings understory community had much lower Native and Total FQI values, indicating that this community is likely a lower quality community or one that does not contain a large number of species conservative to this community type. Despite the low FQI values of the oak openings understory community, it is interesting to note that these values did not decrease by a large margin, thereby indicating the persistence of numerous species that may be restricted to this habitat type. The Native and Total FQI values for the prairie fen, on the other hand, were all above 50, which may indicate rare and significant landscapes (Herman et al. 2001).

State-listed Species

Two of the three state-listed species collected by Gilbert were found during this study. A small population of 29 individuals of *Amorpha canescens* was found in the oak openings understory in 2012, roughly halfway down the power line right-of-way west of the path. The population was surrounded by young black oak saplings about 2 m tall. Two individuals of *Geum virginianum* were found in 2012 within the southern hardwood swamp west of the main esker and northeast of Hall Lake. Gilbert collected this species in 1950 "on sloping sides of Brigham esker." Our collection, which we did not intend to make, closely matches the Gilbert specimen annotated by Voss. If our identification of this population was correct, it should be noted that the occurrence of this species in a swamp is counter to its more typical upland habitat (Voss and Reznicek 2012). See Figure 1 for a map indicating the locations of these two species. *Cypripedium candidum* was found by Gilbert in 1948, but not during the time period of this study. In 1990, Gilbert led the second author to a small population on the west side of the prairie fen between Hall and Dexter Lakes, where it was last observed by him in about 2001. *Brickellia eupatorioides* and *Conioselinum chinense*, both designated as Special Concern after the conclusion of our study, were also documented in 2012. Surprisingly, *B. eupatorioides* was documented in the disturbed oak-hickory forest near the Arlington parking lot, while *C. chinense* was documented near the outlet stream of Brigham Lake.

Comparison with Gilbert's Study

A comparison of the results of this study with those of Gilbert reveals some key differences. The fact that Dr. Gilbert conducted a floristic inventory over approximately nine growing seasons is not necessarily evidence of the comprehensiveness of his checklist, which does not include some graminoids and Aster-

aceae that were likely present. Likewise, the short time frame in which the main part of our study was done (1.5 growing seasons) probably limits the comprehensiveness of our collections. The number of willow species documented provides evidence of the differences in sampling intensities; only two of nine species of *Salix* that Gilbert collected were documented in our study. It should be noted that Gilbert's collections of *Salix* were identified by Dr. Carleton Ball, a noted willow expert of the day.

In support of our hypothesis, we found that both the number and the percentages of introduced and invasive species have increased since Gilbert's study. While Gilbert found 63 introduced species (13.7% of his total species count) and 37 invasive species (8.0%), the numbers of both have increased to 123 (20.5% of the total number of species found at the Ott preserve) and 67 (11.0%), respectively. Thus, there has likely been significant introduction of non-native species into the preserve since the 1950s. Furthermore, 171 species collected by Gilbert were not found in this study. This not to say necessarily that these species have been extirpated from the property; a continuation of this study would be necessary to make such a conclusion. Nonetheless, the addition of a substantial number of non-native species suggests an overall decline in the natural value of the property, and possibly also in its ecosystem health. Alternatively, the presence of several high-quality vulnerable Michigan communities in the Ott Preserve may indicate that the natural value of this property is greater than it was historically when development and habitat loss were less widespread.

Finally, there is significant evidence that succession has been a key factor affecting the biodiversity of oak openings and savanna species. Gilbert collected numerous species from the Ott Preserve that he described as occurring in "open hillsides and sandy slopes," many of which were from the west side of the property near the neighborhood of Brownlee Park. These habitats simply no longer exist in the same state. Numerous locations in what is now oak-hickory forest were once described as open, such as the areas on the then south side of the preserve. Succession, no doubt affected by fire suppression, is most likely the reason for the change in landscape. Perhaps due to this successional change, we noted several species common to prairies or open woodlands that Gilbert collected but were not documented in this study. Notable species that might have been extirpated from these areas are *Asclepias viridiflora* (Green milkweed), *Crocanthemum bicknellii* (Frostweed), *Drymocallis arguta* (Tall cinquefoil), *Hieracium longipilum* (Prairie hawkweed), *Minuartia michauxii* (Rock sandwort), *Tephrosia virginiana* (Goat's-rue), and *Viola pedata* (Birdfoot violet).

Management Considerations

While the goal of a nature preserve is to keep the land in its natural state, there may be some courses of action that are needed to keep these component natural communities from becoming degraded. All of the communities present are listed as S3 at best, which means that they are vulnerable due to a restricted range with widespread declines in Michigan (Kost et al. 2007). Therefore, it is essential to preserve these potentially fragile communities before further degradation takes place. When looking to manage or restore any of these communities,

managers should keep in mind any animals that might be affected by such actions or that could benefit from them, such as the spotted turtles (*Clemmys guttata*) and box turtles (*Terrapene carolina*) found in the prairie fen or the box turtles in the dry-mesic southern forest.

The dry-mesic southern forest is much less open than it was historically, likely due to the result of succession. There are very few wildflowers growing among the young oak or hickory trees. According to the Michigan Natural Features Inventory (MNFI), fire is the single most significant factor in preserving oak ecosystems (Lee 2007), as it promotes oak regeneration and reduces encroachment by invasive shrubs, both of which are necessary for the long-term vitality of this community. The MNFI also suggests orchestrating prescribed burns in this community, as well as with other fire-dependent communities, such as prairies and prairie fens (Lee 2007). Cutting, followed by the application of herbicide to stumps, may be another way to combat invasive shrubs. Other invasives, including garlic mustard (*Alliaria petiolata*), are prevalent along trails and may have become established initially on the Sutarek tract, from which they are spreading in the absence of management. It is recommended that areas with populations of garlic mustard be targeted, rather than initiating wide but sparse efforts of control (Pardini et al. 2009). Hand pulling adult plants before flowering is one of the most common methods used for control (Pardini et al. 2009).

The health of southern hardwood swamps relies on the connection to adjacent upland habitats, as the hydrology of these areas greatly affects the plant and animal species therein Slaughter (2009). Disturbances in the swamp areas could lead to incursions by invasives, so it is essential to minimize any further development of trails in these habitats. Japanese barberry (*Berberis thunbergii*), a relatively common invasive species in the Ott's swamps, and which was collected by Gilbert in 1950 "under second growth upland hardwood," may very likely become more of a problem if left untreated. Propane torches have provided an effective non-chemical treatment in the New England States, resulting in 75% reduction in stands (Ward et al. 2009). Herbicide applications are also effective in reducing stands of barberry (Ward et al. 2009). In addition, this community type is currently experiencing change due to the presence of the emerald ash borer (*Agrilus planipennis*) (EAB). This invasive beetle has already caused the death of the majority of individuals of *Fraxinus nigra* (black ash) and *F. pennsylvanica* (green ash) individuals in the Ott's swamps (Bowen and Stevens 2018). There is concern for the persistence of ash wetlands in the Great Lakes region as a result of EAB depredations. Ashes are common canopy trees in swamps, and even occasionally occur in pure stands (Erdmann et al. 1987; Palik et al. 2011; Slesak et al. 2014; Levin-Nielsen and Rieske 2015; Iverson et al. 2016). In addition to potential compositional and structural changes, the death of ash trees may cause hydrological changes in southern hardwood swamps, potentially leading to ecosystem alteration (Slesak et al. 2014). A study by Bowen and Stevens (2018) found that the percentage basal area of ash in the hardwood swamp at the Ott Preserve was relatively low (12.35%) and that the canopy of red maple (*Acer rubrum*), American basswood (*Tilia americana*), and yellow birch (*Betula alleghaniensis*) would likely fill in tree gaps resulting from the death of ash trees.

The oak openings understory at the Ott Preserve is highly disturbed and re-

stricted to the area adjacent to the Consumers Energy power line right-of-way on the west boundary of the preserve. Numerous introduced species, notably grasses, have become very common throughout the area and may be outcompeting native grass and forb species. Jackson (1968) made transects in this area and found *Andropogon virginicus* (broom-sedge) to be a dominant species of her upland non-forested community type. Neither Gilbert nor we collected this species but it likely occurs there. We did make recent collections of *Schizachyrium scoparium* (little bluestem), a superficially similar species.

Perhaps a larger problem for this area is the aggressive growth of shrubs such as the invasive *Elaeagnus umbellata* (autumn olive), and the natives *Quercus velutina* (black oak) and *Corylus americana* (hazelnut). In addition, this open community once extended much further east into an area that is now a closed canopy oak-hickory forest. Restoring and managing this oak opening will require the containment of the woody encroachment in both open areas and in neighboring forest, either by frequent fire, selective thinning, or both, leaving between 10 and 60% of the canopy (White 1986, Cohen 2004). The timing for any such burns, which admittedly are unlikely here, will produce differential effects, with spring burns favoring warm season grasses and late flowering species and fall burns favoring cool season grasses and early flowering species (Kline 1997). Such encroachment has occurred directly adjacent to the small population of the special concern species *Amorpha canescens* (lead-plant). Conservation of this population will require the control of encroaching young trees, as lead-plant requires full or partial sunlight (Fryer 2011). Efforts should be made to ensure that Consumers Energy is aware of the rarity of this community type and avoids the extensive use of broad-spectrum herbicides for tree control in this area.

The prairie fen is arguably the most interesting community type present at the Ott Preserve because of its orchid diversity and carnivorous plants. Many prairie fens in Michigan have been damaged by reduced water levels, which has encouraged the establishment of shrubs and trees (Spieles et al. 1999). Tamarack trees (*Larix laricina*), on the other hand, seem to be declining as much as during Catana's 1967 study as evidenced by the numerous dead individuals surrounding this area. *Typha angustifolia*, and *Typha* \times *glauca* (the hybrid and various backcrosses between introduced *T. angustifolia* and native *T. latifolia*) were not collected by Gilbert. They, along with *Frangula alnus*, are major invasive threats to this fen.

Ten orchid species were collected by Gilbert (see Appendix 1); of these, only *Calopogon tuberosus* (grass-pink) and *Pogonia ophioglossoides* (rose pink) were documented during this study. However, because of the relatively short time span of our study, no conclusions can be made as to whether the other eight species still occur at the Ott Preserve. Indeed, since some orchids do not emerge every year due to water level changes, it is possible that they were not seen because environmental conditions were not optimal. The introduction of fire or manual removal of invasive, woody shrubs such as glossy buckthorn have been shown to be effective methods for controlling these woody exotics (Zimmerman 1983). Over the last several years, an added threat to the prairie fen is beaver activity that has blocked the main drains of both Brigham Hall Lakes. For example, most of the pitcher plants that occurred in the largest fen, which is between Hall Lake

and Dexter Lake, are no longer visible; they were seen submerged under ca. 10 cm of water in 2015. The only pitcher plants seen in 2018 were at slightly elevated areas on hummocks near the margins of the lakes. The drains should be re-opened to maintain native biodiversity in this community.

ACKNOWLEDGMENTS

We dedicate this study to Dr. William J. Gilbert (1916–1994), whose collections first documented the flora of the Ott Preserve. We thank Albion College's Foundation for Undergraduate Research, Scholarship, and Creative Activity (FURSCA) and the James W. Hyde Endowed Student Research Fellowship for support during Summer 2012. The first author also thanks the Department of Biology of Albion College and acknowledges the support of the Marilyn Young Vitek Merit Scholarship. Dr. Kevin Metz, Assistant Professor of Chemistry, and Dr. Sheila Lyons-Sobaski, Associate Professor of Biology, made helpful comments on earlier drafts of this paper. The second author thanks Dr. Ewell A. Stowell (1922–2009) for his records on the Ott Preserve and, who, with Dr. Gilbert, introduced him to the preserve. We thank Dr. Anton Reznicek of MICH, who was kind enough to examine some of our more difficult graminoid specimens. We thank Justin Seidler (Albion College Archives and Special Collections) and Jennifer Wood (Albion District Library, Local History Room), who made their collections available to us, and Annette Chapman, Dr. William Comai, and Doug Sophia for historical information and for their tireless efforts on behalf of the preserve. We also thank the Calhoun County Board of Commissioners, especially its former Chair, Arthur Kale, for permission to conduct this study. Former Calhoun County Corporation Counsel Richard Lindsey and GIS Coordinator Brent Thelan were especially helpful. Members of the Calhoun County Trailway Alliance have the first author's thanks for allowing her to present material to them about plant communities and the impact of various trail placements. This paper is based on a thesis submitted by the first author in partial fulfillment of requirements for the Bachelor of Arts with Honors at Albion College.

LITERATURE CITED

All letters and other unpublished documents used for writing the history of the Ott Preserve section are deposited in the Archives and Special Collections depository at the Albion College Library.

- Adams, D. R. (1976). Letter to Steven E. Pugsley, Director, Calhoun County Department of Planning and Development Coordination, from Dennis R. Adams, Assistant Grants Coordinator, Michigan DNR, January 14, 1976.
- Angiosperm Phylogeny Group (2016). An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG IV. *Botanical Journal of the Linnean Society* 181: 1–20.
- Anonymous. (1995). Ott Biological Preserve...area treasure. *The Marshall Community Ad-visor*, November 15, 1995.
- Ballou, K. C. (1949). A general survey of the protozoa collected at the Harvey N. Ott Biological Preserve. Unpublished Master's thesis. Albion College, Albion, Michigan.
- Basso, D. R. (1994). Rush of public opinion halts Ott tree cutting. *Marshall Chronicle*, Marshall, Michigan, March 5, 1994.
- Bishop, L. J. (1971). Letter to Donald Nagel, President of Calhoun County Parks and Recreation Commission, from L. James Bishop, Albion College Business Manager, March 19, 1971.
- Bossdorf, O., H. Auge, L. Lafuma, W. E. Rogers, E. Siemann, and D. Prati. (2005). Phenotypic and genetic differentiation between native and introduced plant populations. *Oecologia* 144: 1–11.
- Bowen, A. K. M. and M. H. H. Stevens. (2018). Predicting the effects of emerald ash borer (*Agrilus planipennis*, Buprestidae) on hardwood swamp forest structure and composition in southern Michigan. *Journal of the Torrey Botanical Society*. 145: 41–54.
- Brewer, R. (2003). *Conservancy: The land trust movement in America*, 1st edition. University Press of New England, Lebanon, New Hampshire.
- Calhoun County Board of Commissioners. (1977). Meeting Minutes, June 6, 1977, dated June 8, 1977. Unpublished document.

- Calhoun County Board of Commissioners. (2015a). Proceedings of the Board of Commissioners, February 5, 2015. Available at https://www.calhouncountymi.gov/assets/1/7/BOC_minutes_020515.pdf. (Accessed January 17, 2018).
- Calhoun County Board of Commissioners. (2015b). Proceedings of the Board of Commissioners, June 4, 2015. Available at https://www.calhouncountymi.gov/assets/1/7/BOC_minutes_060415.pdf. (Accessed January 29, 2018).
- Calhoun County Board of Commissioners. (2017). Proceedings of the Board of Commissioners, March 16, 2017. Available at https://www.calhouncountymi.gov/assets/1/7/BOC_minutes_031617.pdf. (Accessed January 17, 2018).
- Calhoun County Community Development. (2015). Calhoun County Parks and Recreation master plan, 2015-2019. Available at <https://www.calhouncountymi.gov/DownloadTracking.aspx?DocumentId=2272>. (Accessed January 17, 2018).
- Calhoun County, Michigan. (2016a). Ott Biological Preserve management and maintenance plan released for public comment. Available at https://www.calhouncountymi.gov/ott_biological_preserve_management_and_maintenance_plan_released_for_public_comment/. (Accessed January 17, 2018).
- Calhoun County, Michigan. (2016b). Ott Biological Preserve management and maintenance plan. Available at <https://www.calhouncountymi.gov/DownloadTracking.aspx?DocumentId=2215>. (Accessed January 17, 2018).
- Catana, A. J., Jr. (1964). Director's Report, Harvey N. Ott Biological Preserve, Albion College, June 1, 1964 to September 30, 1964. Unpublished document.
- Catana, A. J., Jr. (1966). Director's Report, Harvey N. Ott Biological Preserve, Albion College, June 1, 1965 to June 1, 1966. Unpublished document.
- Catana, A. J., Jr. (1967). Forests of the Harvey N. Ott Preserve. *The American Midland Naturalist* 78: 496-507.
- Catana, A. J., Jr. (1971). Director's Report, Albion College Natural Areas, Albion College, October 1, 1970 to January 1, 1971. Unpublished document.
- Chapman, K. A. (1984). An ecological investigation of native grassland in Southern Lower Michigan. M.A. thesis. Western Michigan University. 235 pp.
- Chapman, K. A., and Brewer, R. (2008). Prairie and savanna in southern lower Michigan: History, classification, ecology. *The Michigan Botanist* 47: 1-48.
- Cohen, J. G. (2004). Natural community abstract for oak openings. Michigan Natural Features Inventory. Lansing, MI. 17 pp.
- Cohen, J. G., M. A. Kost, B. S. Slaughter, and D. A. Albert. (2014). A field guide to the natural communities of Michigan. Michigan State University Press, East Lansing, Michigan.
- Comer, P.J., D. A. Albert, H. A. Wells, B. L. Hart, J. B. Raab, D. L. Price, D. M. Kashian, R. A. Corner, and D. W. Schuen. 1995. Michigan's native landscape, as interpreted from the General Land Office surveys 1816-1856. Report to USEPA. Water Division and Wildlife Division, Michigan Department of Natural Resources, Michigan Natural Features Inventory. Lansing, Michigan.
- Curtis, J.T. (1959). Vegetation of Wisconsin: An Ordination of Plant Communities. University of Wisconsin Press. Madison, WI. 657 pp.
- Erdmann, G. G., T. R. Crow, R. M. Peterson, Jr., and C. D. Wilson. (1987). Managing black ash in the Lake States. General Technical Report NC-115. United States Department of Agriculture, Forest Service, North Central Forest Experiment Station, St. Paul, Minnesota.
- ESRI. (2018). ArcGIS Desktop: Release 10.6.1 Redlands, CA: Environmental Systems Research Institute.
- Freyman, W. A., L. A. Masters, and S. Packard. (2016). The universal floristic quality assessment (FQA) calculator: An online tool for ecological assessment and monitoring. *Methods in Ecology and Evolution* 7: 380-383.
- Friends of the Ott Preserve. (1996). Annual Report. Unpublished document.
- Friends of the Ott Preserve. (1997). Annual Report. Unpublished document.
- Fryer, J. L. (2011). *Amorpha canescens*. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available at <https://www.fs.fed.us/database/feis/plants/shrub/amocan/all.html>. (Accessed November 20, 2018).
- Garnett, T. and J. Coury. (2010). Letter to Calhoun County Commissioners with Ott Preserve Review and Timeline and Calhoun County Trailway Timeline, November 24, 2010.

- Gilbert, W. J. (1954). The Harvey N. Ott Biological Preserve of Albion College. *Michigan History* 38: 157–167.
- Gilbert, W. J. (1970). Ott Preserve and the “60 Acres.” Memorandum to Dean McIntyre, Albion College, July 13, 1970. Unpublished document.
- Grant, C. W. (1927). Preliminary topographical and biological survey of the Battle Creek College Biological Preserve. Unpublished Master’s thesis. Battle Creek College, Battle Creek, Michigan.
- Herman, K. D., L. A. Masters, M. R. Penskar, A. A. Reznicek, G. S. Wilhelm, W. W. Brodovich, and K. P. Gardiner. (2001). Floristic quality assessment with wetland categories and examples of computer applications for the State of Michigan, Revised, second edition. Michigan Department of Natural Resources, Wildlife Division, Natural Heritage Program, Lansing, Michigan.
- Horvath, V. G. (1977). Letter to Steven Pugsley, Director, CCRC, from Victor Horvath, Grants Coordinator, Michigan DNR, May 10, 1977.
- Huisman, K., A. Graeff, and P. J. Laureto. (2012). Hybridization dynamics of invasive cattail stands at Pierce Cedar Creek Institute: A molecular analysis. *The Michigan Botanist* 51: 89–99.
- Iverson, L., K. S. Knight, A. Prasad, D. A. Herms, S. Matthews, M. Peters, A. Smith, et al. (2016). Potential species replacements for black ash (*Fraxinus nigra*) at the confluence of two threats: Emerald ash borer and a changing climate. *Ecosystems* 19: 248–270.
- Jackson, M. J. (1968). Non-forest vegetation of the Harvey N. Ott Preserve. Unpublished undergraduate thesis. Albion College, Albion, Michigan.
- Judziewicz, E. J. (2004). A thirty-year study of the vascular plants of “Butternut Pines,” a 40-acre tract in Oconto County, Wisconsin. *The Michigan Botanist* 43: 81–115.
- Kline, V. M. (1997). Planning a restoration. Pp. 31–46 in S. Packard and C. F. Mutel, eds., *The Tallgrass Restoration Handbook*. Island Press, Washington, D.C.
- Kost, M. A., D. A. Albert, J. G. Cohen, B. S. Slaughter, R. K. Schillo, C. R. Weber, and K. A. Chapman. (2007). Natural communities of Michigan: Classification and description. Michigan Natural Features Inventory, Report No. 2007-21. Lansing, Michigan. Available at <http://mnfi.anr.msu.edu/communities/index.cfm>. (Accessed June 10, 2015).
- Land Lease Agreement. (1972). Unsigned land lease agreement between Albion College and the Calhoun County Parks and Recreation Commission. Unpublished document.
- Lee, J. G. (2007). Natural community abstract for dry-mesic southern forest. Michigan Natural Features Inventory. Lansing, MI. 16 pp.
- Levin-Nielsen, A., and L. K. Rieske. (2015). Evaluating short term simulations of a forest stand invaded by emerald ash borer. *iForest* 8: 19–24.
- Lomas, B. T. (1980). Letter from Bernard Lomas, President of Albion College, to Gordon Martin, Chairman, Calhoun County Board of Commissioners, May 1, 1980.
- McCauley, L. A., D. G. Jenkins, and P. F. Quintana-Ascencio. (2013). Isolated wetland loss and degradation over two decades in an increasingly urbanized landscape. *Wetlands* 33:117–127.
- McIntyre, D. (1969). Ott Preserve. Memorandum to Dr. William J. Gilbert, July 24, 1969. Unpublished document.
- Michigan Flora Online. A. A. Reznicek, E. G. Voss, and B. S. Walters. (2011). University of Michigan. Available at <http://michiganflora.net/information.aspx>. (Accessed July 29, 2016).
- Michigan Natural Features Inventory. (2009). Michigan’s Rare Plants. Endangered Species Program of the Michigan Department of Natural Resources. Available at <https://mnfi.anr.msu.edu/species/plants>. (Accessed November 20, 2018).
- Michigan State University. (2018). Midwest Invasive Species Information Network. Available at <http://www.misin.msu.edu/facts/>. (Accessed January 23, 2018).
- Nagel, D. E. (1972). Letter to Ewell Stowell, Director of Natural Areas, Albion College Biology Department, from Donald Nagel, President, CCPRC, November 3, 1972.
- Overholt, B. M. (1929). Survey of the flowering spring flora of the Battle Creek College Biological Preserve. Unpublished undergraduate thesis. Battle Creek College, Battle Creek, Michigan.
- Palik, B. J., M. E. Ostry, R. C. Venette, and E. Abdela. (2011). *Fraxinus nigra* (black ash) dieback in Minnesota: Regional variation and potential contributing factors. *Forest Ecology and Management* 261: 128–135.
- Pardini, E. A., J. M. Drake, J. M. Chase, and T. M. Knight. (2009). Complex population dynamics and control of the invasive biennial *Alliaria petiolata* (garlic mustard). *Ecological Applications* 19: 387–397.
- Parks, C. (1993). Contract between Michigan Veneer & Hardwood Inc., Clifford Parks, President,

- and Calhoun County, November 18, 1993. Signed by Michael Nofs, Chair of the Calhoun County Board of Commissioners, December 6, 1993. Unpublished document.
- PPG I (2016). A community derived classification for extant lycophytes and ferns. *Journal of Systematics and Evolution* 54: 563-603.
- PRISM Climate Group. (2004). 30-Year Normals. Oregon State University. Available at <http://prism.oregonstate.edu>. (Accessed November 18, 2018).
- Reilly, D. (1977). Letter from Dennis Reilly, Deputy Director, Calhoun County Parks and Recreation Commission, to Ewell A. Stowell, Professor of Biology, Albion College. September 8, 1977.
- Reznicek, A. A., M. R. Penskar, B. S. Walters, and B. S. Slaughter. (2014). Michigan floristic quality assessment database. Herbarium, University of Michigan, Ann Arbor and Michigan Natural Features Inventory, Michigan State University, Lansing. Available at <http://michiganflora.net/home.aspx>. (Accessed August 3, 2016).
- Rompf, M. (1980). Calhoun County parks to be closed soon? *Albion Evening Recorder*, Albion, Michigan, April 30, 1980 p. 3.
- Slaughter, B. S. (2009). Natural community abstract for southern hardwood swamp. Michigan Natural Features Inventory. Lansing, MI. 16 pp.
- Slesak, R. A., C. F. Lenhart, K. N. B. Brooks, A. W. D'Amato, and B. J. Palik. (2014). Water table responses to harvesting and simulated emerald ash borer mortality in black ash wetlands, Minnesota USA. *Can. J. For. Res.* 968: 961-968.
- Soil Survey Staff. n.d. Natural Resources Conservation Service, United States Department of Agriculture. Web Soil Survey. Available online at the following link: <https://websoilsurvey.sc.egov.usda.gov/>. (Accessed November 18, 2018).
- Spieles, J. B., P.J. Comer, D. A. Albert, and M. A. Kost. (1999). Natural community abstract for prairie fen. Michigan Natural Features Inventory. Lansing, MI. 5 pp.
- Stowell, E. A. (1964). Minutes of the Harvey N. Ott Biological Preserve Advisory Committee. Unpublished minutes, June 10, 1964.
- Tardy, S. W. (1997). Soil survey of Calhoun County, Michigan. United States Department of Agriculture, Natural Resources Conservation Service. Washington, D.C.
- Tester, J. R. (1989). Effects of fire frequency on oak savanna in east-central Minnesota. *Bulletin of the Torrey Botanical Club* 116 (2): 134-144.
- Tilman, D., P. B. Reich, and J. M. H. Knops. (2006). Biodiversity and ecosystem stability in a decade-long grassland experiment. *Nature* 441: 629-632.
- USGS. (1999). National Elevation Dataset (NED). EROS Data Center. Available at <https://catalog.data.gov/dataset/usgs-national-elevation-dataset-ned>. (Accessed November 18, 2018).
- van Andel, J., and J. Aronson, editors. (2012). *Restoration ecology: The new frontier*, 2nd edition. Wiley-Blackwell, Chichester, West Sussex, Hoboken, New Jersey.
- Voss, E. G. (1972). Michigan flora, part I: Gymnosperms and monocots. *Cranbrook Institute of Science Bulletin* 55 and the University of Michigan Herbarium, Cranbrook.
- Voss, E. G. (1985). Michigan flora, part II: Dicots (Saururaceae – Cornaceae). *Cranbrook Institute of Science Bulletin* 59 and the University of Michigan Herbarium, Ann Arbor.
- Voss, E. G. (1996). Michigan flora, Part III: Dicots (Pyrolaceae – Compositae). *Cranbrook Institute of Science Bulletin* 61 and the University of Michigan Herbarium, Ann Arbor.
- Voss, E. G., and A. A. Reznicek. (2012). *Field manual of Michigan flora*. The University of Michigan Press, Ann Arbor.
- Ward, J. S., T. E. Worthley, and S. C. Williams. (2009). Controlling Japanese barberry (*Berberis thunbergii* DC.) in southern New England, USA. *Forest Ecology and Management* 257: 561-566.
- White, A. S. (1986). Prescribed burning for oak savanna restoration in central Minnesota. Research Paper NC-266. U.S. Department of Agriculture, Forest Service. North Central Forest Experiment Station. St. Paul, MN. 12 pp.
- Zimmerman, J. H. (1983). The revegetation of a small Yahara Valley prairie fen. *WI Academy of Science, Arts, and Letters* 71: 87-102.

APPENDIX 1. Annotated Checklist of the Vascular Plants of the Ott Biological Preserve

The following is a checklist of vascular plant species collected at the Harvey N. Ott Preserve primarily from 1946-1954 by Dr. William Gilbert, from September 2011 to October 2012 by the authors, and thereafter by the second author and his other students concluding in 2016. The list is arranged by major phylogenetic group. Within each such group, the families, genera, and species are listed alphabetically. Family circumscriptions for lycophytes and ferns follow PPG I (2016). Angiosperm family circumscriptions follow APG IV (Angiosperm Phylogeny Group 2016). Families that differ from these that are recognized by Michigan Flora Online (2011) are listed and referenced to APG IV family placements. Common names follow Voss and Reznicek (2012). A total of 461 species, including varieties, forms, and subspecies were vouchered by Gilbert, and an additional 138 species were vouchered by recent collections.

Many easy-to-identify species were noted in the field by us were not vouchered because a previous collection by Gilbert exists. These taxa are indicated by the notation "Recent observation." Those collected by Gilbert and not vouchered or noted by us are indicated by the notation "No recent observation". Species noted by Gilbert in his manuscript, but for which there is no specimen in ALBC, are excluded from this checklist. Indications of habitat and frequency of occurrence for species collected only by Gilbert and not observed by us are taken directly from specimen labels; for these the name change from Blanck Lake to Dexter Lake is the only correction. It should also be noted that descriptions such as "bog" or "boggy" were used extensively by Gilbert but do not necessarily coincide with current natural community designations. An asterisk (*) preceding a species name indicates a species not recorded for Calhoun County in Michigan Flora Online (2011) as of November 27, 2018, unless it is based on a collection from this study. Non-native species, as indicated in Michigan Flora Online (2011), are indicated in bold. Collection numbers are preceded by the collector's surname (Miller indicates the first author Bowen).

LYCOPHYTES

LYCOPODIACEAE

Huperzia lucidula (Michx.) R. Trevis, Shining clubmoss, hardwood swamp, *Gilbert 482, 50102, 50121*. Recent observation.

SELAGINELLACEAE

Selaginella eclipses W.R. Buck, Selaginella, occasional on prairie fen, *Gilbert 461, 4617, 4622*. Recent observation.

MONILOPHYTES (FERNS)

EQUISETOPHYTES

EQUISETACEAE

Equisetum arvense L., Common horsetail, wet spring area around Hall Lake, *Gilbert 4616, 54018*. No recent observation.

**E. laevigatum* A. Braun, Smooth scouring rush, locally common near end of Consumers Energy power line right-of-way remnant oak openings understory, on prairie fen, and occasional in disturbed oak-hickory forest on N side of property, *Gilbert 4621, Miller 94, 126, 199*.

OPHIOGLOSSOPHYTES

OPHIOGLOSSACEAE

Botrypus virginianus (L.) Michx., Rattlesnake fern, occasional in oak-hickory forest on N side of property, *Gilbert 49336, 4630*. Recent observation.

Sceptridium dissectum (Spreng.) Lyon, Cut-leaved grape-fern, occasional on wet margin of Bringham Lake, *Gilbert 49336, 54016*. Recent observation.

LEPTOSPORANGIATES

ASPLENIACEAE

**Asplenium platyneuron* (L.) D. C. Eaton, Ebony spleenwort, occasional E of Jameson parking lot and on NW side of property in disturbed oak-hickory forest, *Miller 82, 135*.

ATHYRIACEAE

Athyrium filix-femina (L.) Roth, Lady fern, locally common in hardwood swamp W of east esker, *Gilbert 50116, Miller 201.*

BLECHNACEAE

Woodwardia virginica (L.) Smith, Virginia chain-fern, in thick brush in W swamp, *Gilbert 5065.* No recent observation.

DENNSTAEDTIACEAE

**Pteridium aquilinum* (L.) Kuhn, Bracken fern, common in oak-hickory forest, *Gilbert 462.* Recent observation.

DRYOPTERIDACEAE

Dryopteris carthusiana (Vill.) H.P. Fuchs, Spinulose woodfern, occasional in oak-hickory forest and hardwood swamp, *Gilbert 4625, 4626, 4628, 50123, 54022, Miller 77, 170.*

D. cristata (L.) A. Gray, Crested shield fern, uncommon in hardwood swamp W of east esker, *Gilbert 4627, 54019, Miller 202.*

**D. intermedia* (Willd.) A. Gray, Evergreen woodfern, occasional in hardwood swamp W of east esker, *Miller 203.*

Polystichum acrostichoides (Michx.) Schott., Christmas fern, occasional in oak-hickory forest and hardwood swamp, *Gilbert 4925.* Recent observation.

ONOCLEACEAE

Onoclea sensibilis L., Sensitive fern, locally common on wet margin of pond at end of power line right-of-way and common in swamps on N side of property, *Gilbert 468, Miller 220.*

OSMUNDACEAE

**Osmundastrum cinnamomeum* (L.) C. Presl, Cinnamon fern, common in hardwood swamp, *Gilbert 464.* Recent observation.

**Osmunda regalis* L., Royal fern, common in swamps on N side of property, *Gilbert 463.* Recent observation.

THELYPTERIDACEAE

**Thelypteris palustris* Schott, Marsh fern, common in boggy area around Brigham Lake and locally common in hardwood swamp, *Gilbert 49465, 5235.* Recent observation.

PTERIDACEAE

**Adiantum pedatum* L., Maidenhair fern, occasional in oak-hickory forest on N side of property, *Gilbert 54017.* Recent observation.

CONIFERS

CUPRESSACEAE

Juniperus communis L., Common juniper, bordering *Sphagnum* mat at N end of Brigham Lake, *Gilbert 49190.* No recent observation.

J. virginiana L., Red-cedar, occasional along Consumers Energy power line right-of-way remnant oak openings understory, *Gilbert 49505, Miller 97, 98.*

PINACEAE

Larix laricina (Du Roi) K. Koch, Larch, common in wet margin of prairie fen near Hall and Dexter Lake, *Gilbert 49146.* Recent observation.

**Picea abies* (L.) H. Karst., Norway spruce, occasional on NW side of property in oak-hickory forest, *Miller 140.*

P. mariana (Mill.) Britton, Sterns & Poggenb., Black spruce, second-growth hardwood, N of Brigham Lake, *Gilbert 51001.* No recent observation.

Pinus strobus L., White pine, occasional along Consumers Energy power line right-of-way remnant oak openings understory, *Miller 96.*

**P. sylvestris* L., Scots pine, uncommon on border of remnant oak openings understory and oak-hickory forest, *Miller 218.*

TAXACEAE

- **Taxus canadensis* Marshall, Yew, rare (only one plant) on NW side of property in oak-hickory forest, *Miller 152*.

ANGIOSPERMS

ADOXACEAE

- Sambucus canadensis* L., Elderberry, locally common on Consumers Energy power line right-of-way in remnant oak openings understory, *Gilbert 49197*. Recent observation.
Viburnum acerifolium L., Maple-leaved viburnum, common in oak-hickory forest, *Gilbert 505, 50126*. Recent observation.
**V. dentatum* L., Arrow-wood, occasional in hardwood swamp NE of Hall Lake, *Miller 211*.
V. lentago L., Nannyberry, Wet margin of prairie fen, *Gilbert 49279, 49434, 49470, 5028*. Recent observation.
V. trilobum Marshall, American highbush-cranberry, occasional in hardwood swamp, *Gilbert 49193*. Recent observation.
V. rafinesquianum Schult., Downy arrow-wood, common on sandy ridges, *Gilbert 49142*. No recent observation.

ALISMATACEAE

- Sagittaria latifolia* Willd., Wapato, Hall Lake submerged aquatic and locally common in boggy area on SW side of Brigham Lake, *Gilbert 49358, 49400, 50105, 49439, 50144, Miller 241*.

ALLIACEAE – SEE AMARYLLIDACEAE

AMARANTHACEAE

- **Froelichia gracilis* (Hook.) Moq., Cottonweed, occasional on Consumers Energy power line right-of-way remnant oak openings understory, *Miller 249*.

AMARYLLIDACEAE

- **Allium rotundum* L., Onion, locally common on Consumers Energy trail in remnant oak openings understory, *Miller 171*.
A. tricoccum Aiton, Wild leek, locally common in oak-hickory forest on esker trail, *Gilbert 4995, 49339*. Recent observation.

ANACARDIACEAE

- Rhus glabra* L., Smooth sumac, occasional on Consumers Energy power line right-of-way remnant oak openings understory, *Gilbert 49210*. Recent observation.
R. typhina L., Staghorn sumac, occasional on Consumers Energy power line right-of-way remnant oak openings understory, *Gilbert 49204*. Recent observation.
Toxicodendron radicans (L.) Kuntze, Poison-ivy, common in oak-hickory forest, *Skean 5075*.
T. vernix (L.) Kuntze, Poison sumac, common in wet margin of prairie fen surrounding Hall Lake and occasional in boggy areas around Brigham Lake, *Gilbert 49445*. Recent observation.

APIACEAE (UMBELLIFERAE)

- Angelica atropurpurea* L., Purplestem angelica, hardwood swamp E of Brigham Lake, *Gilbert 49185, 5051*. No recent observation.
Cicuta bulbifera L., Water hemlock, W side of N swamp, *Gilbert 49366, 49476*. No recent observation.
C. maculata L., Water hemlock, wet lowland SE corner of preserve, *Gilbert 49334*. No recent observation.
Conioselinum chinense (L.) Britton, Sterns, & Poggenb., Hemlock-parsley, along outlet stream of Brigham Lake, *Gilbert 49441*. Recent observation.
Daucus carota L., Queen-Anne's-lace, occasional on Consumers Energy power line right-of-way remnant oak openings understory, *Gilbert 49299*. Recent observation.
Osmorhiza claytonii (Michx.) C. B. Clarke, Hairy sweet-cicely, occasional in oak-hickory forest, *Gilbert 4996*. Recent observation.

Oxypolis rigidior (L.) Raf., Cowbane, low moist ground near Hall Lake, *Gilbert* 49415, 49502. No recent observation.

Sanicula marilandica L., Black snakeroot, oak-hickory forest on N side of property, *Gilbert* 49141, 49195. Recent observation.

Taenidia integerrima (L.) Drude, Yellow-pimpernel, on hillside near Brigham Lake, *Gilbert* 4994. No recent observation.

Torilis japonica (Houtt.) DC., Hedge-parsley, occasional along Consumers Energy right-of-way remnant oak openings understory, *Miller* 173.

Zizia aurea (L.) W. D. J. Koch, Golden alexanders, occasional in oak-hickory forest on N side of property, *Gilbert* 49103. Recent observation.

APOCYNACEAE

Apocynum androsaemifolium L., Spreading dogbane, occasional along Consumers Energy right-of-way, *Gilbert* 49169, *Miller* 95.

A. cannabinum L., Indian-hemp, Consumers Energy right-of-way, *Gilbert* 49231. Recent observation.

Asclepias amplexicaulis Sm., Claspig milkweed, uncommon on Consumers Energy right-of-way, *Gilbert* 49332, 50158. Recent observation.

A. exaltata L., Poke milkweed, uncommon in oak-hickory forest on N side of property, *Gilbert* 49218, 49431. Recent observation.

A. incarnata L., Swamp milkweed, occasional on prairie fen and around Hall Lake, *Gilbert* 49268. Recent observation.

A. syriaca L., Common milkweed, occasional on Consumers Energy right-of-way, *Gilbert* 49235, 49307. Recent observation.

A. tuberosa L., Butterfly-weed, common on Consumers Energy right-of-way, *Gilbert* 49288. Recent observation.

A. viridiflora Raf., Green milkweed, sandy soil hill W of north swamp, *Gilbert* 49395, 5035. No recent observation.

****Vincetoxicum nigrum*** (L.) Pers., Black swallow-wort, occasional to locally common on Consumers Energy power line right-of-way remnant oak openings understory, *Miller* 71, 119.

AQUIFOLIACEAE

Ilex mucronata (L.) M. Powell, V. Savolainen & S. Andrews, Mountain holly, west swamp, *Gilbert* 5069. No recent observation.

I. verticillata (L.) A. Gray, Michigan holly, common in swamps on N side of property, *Gilbert* 49490, 5087. Recent observation.

ARACEAE

Arisaema triphyllum (L.) Schott, Jack-in-the-pulpit, occasional in hardwood swamp, *Gilbert* 4943. Recent observation.

Lemna minor L., Common duckweed, common in Brigham Lake, *Gilbert* 52103, *Miller* 233a.

Symplocarpus foetidus (L.) Nutt., Skunk-cabbage, common in hardwood swamp, *Gilbert* 4924. Recent observation.

**Wolffia borealis* (Engelm.) Landolt & Wildi, Dotted water meal, Brigham Lake, *Miller* 233c.
W. columbiana H. Karst, Common water meal, Brigham Lake, *Miller* 233b.

ARALIACEAE

Aralia nudicaulis L., Wild sarsaparilla, locally common in oak-hickory forest on N side of property, *Gilbert* 49102, 49124b, 5024. Recent observation.

****Hedera helix*** L., English ivy, locally common in oak-hickory forest on NW boundary, near trailer park. *Walczyk* 1.

ASPARAGACEAE

Asparagus officinalis L., Garden asparagus, uncommon on Consumers Energy right-of-way, *Gilbert* 49199. Recent observation.

Maianthemum canadense Desf., Wild lily-of-the-valley, locally common in oak-hickory forest on N side of property, *Gilbert* 4999. Recent observation.

- M. racemosum* (L.) Link, False spikenard, occasional in oak-hickory forest, *Gilbert* 4993. Recent observation.
- M. stellatum* (L.) Link, Starry false solomon-seal, occasional in oak-hickory forest, *Gilbert* 49104. Recent observation.
- Polygonatum biflorum* (Walter) Elliot, Solomon-seal, S side of hill on main esker N of Brigham Lake, *Gilbert* 49114, 49115, 54026, 54027. No recent observation.
- P. pubescens* (Willd.) Pursh, Downy solomon seal, occasional in oak-hickory forest, *Gilbert* 4980, 49114. Recent observation.
- Uvularia grandiflora* Sm., Bellwort, occasional in oak-hickory forest, *Gilbert* 4834. Recent observation.

ASPHODELACEAE

- Hemerocallis fulva* (L.) L.**, Orange day-lily, locally common in disturbed oak-hickory forest near power line right-of-way, *Gilbert* 5230. Recent observation.

ASTERACEAE (COMPOSITAE)

- Achillea millefolium* L., Yarrow, common on Consumers Energy right-of-way remnant prairie, *Gilbert* 49160. Recent observation.
- Ageratina altissima* (L.) R. M. King & H. Rob, White snakeroot, border of small E swamp, *Gilbert* 49430. No recent observation.
- Ambrosia artemisiifolia* L., Common ragweed, occasional on Consumers Energy right-of-way remnant oak openings understory e, *Gilbert* 49464. Recent observation.
- Antennaria parlinii* Fernald, Smooth pussytoes, common on sandy hills, *Gilbert* 4942. No recent observation.
- Arctium minus* Bernh.**, Common burdock, disturbed oak-hickory forest, *Gilbert* 49354. Recent observation.
- Arnoglossum atriplicifolium* (L.) H. Rob., occasional on Consumers Energy right-of-way remnant oak openings understory, Pale Indian Plantain, *Gilbert* 49343. Recent observation.
- Bidens cernua* L., Nodding beggar-ticks, occasional on W side of Hall Lake on wet margin of prairie fen and in dried up swamp on N side of property, *Miller* 142, 179, *Skean* 5025.
- B. trichosperma* (Michx.) Britt., Tickseed-sunflower, occasional in prairie fen near Hall Lake, *Gilbert* 50170, *Miller* 271, 275.
- Brickellia eupatorioides* (L.) Shinnery, False boneset, disturbed oak-hickory forest near Arlington entrance, *Gilbert* 50148, *Miller* 266.
- Centaurea diffusa* Lam.**, Brown knapweed, border of E Hall Lake, *Gilbert* 54068. No recent observation.
- C. stoebe* L.**, Spotted knapweed, common on Consumers Energy power line right-of-way remnant oak openings understory, *Gilbert* 523. Recent observation.
- Cichorium intybus* L.**, Chicory, Locally common on Consumers Energy power line right-of-way remnant oak openings understory, *Gilbert* 5041. Recent observation.
- Cirsium muticum* Michx., Swamp thistle, common in hardwood swamp lake edges, *Gilbert* 49414. Recent observation.
- C. vulgare* (Savi) Ten.**, Bull thistle, along roadside on sandy hillside, *Gilbert* 52111. No recent observation.
- Conyza canadensis* (L.) Cronq., Horseweed, common along Consumers Energy power line right-of-way, *Gilbert* 50131. Recent observation.
- Coreopsis tripteris* L., Tall tickseed, common on Consumers Energy power line right-of-way in remnant oak openings understory, *Gilbert* 49405. Recent observation.
- Erigeron pulchellus* Michx., Robin's-plantain, common in disturbed and open sandy areas, *Gilbert* 49109, 509. Recent observation.
- E. strigosus* Muhl., Daisy fleabane, locally common on Consumers Energy power line right-of-way in remnant oak openings understory, *Gilbert* 49203. Recent observation.
- Eupatorium perfoliatum* L., Boneset, wet soil bordering springs E of Brigham Lake, *Gilbert* 49437. No recent observation.
- Eurybia macrophylla* (L.) Cass., Large-leaved aster, upland hardwood, *Gilbert* 50118. Recent observation.
- Euthamia graminifolia* (L.) Nutt., Grass-leaved goldenrod, locally common on Consumers Energy power line right-of-way in remnant oak openings understory, *Miller* 219.

- Eutrochium maculatum* (L.) E. E. Lamont, Joe-pye-weed, wet margins of Hall Lake, *Gilbert* 49386, 49404. Recent observation.
- Helianthus divaricatus* L., Woodland sunflower, locally common on Consumers Energy power line right-of-way in remnant oak openings understory, *Gilbert* 49301, *Miller* 256, 257.
- H. giganteus* L., Tall sunflower, uncommon on W side of Hall Lake on wet margin of prairie fen and in oak-hickory forest near Arlington entrance, *Gilbert* 49398, *Miller* 230, 264.
- H. occidentalis* Riddell, Western sunflower, S end of Hall esker, *Gilbert* 49402. No recent observation.
- Hieracium aurantiacum* L., Orange hawkweed, occasional in oak-hickory forest on N side of property, *Gilbert* 49155. Recent observation.
- H. caespitosum* Dumort., Yellow hawkweed, occasional along Consumers Energy power line right-of-way trail remnant oak openings understory, *Miller* 92.
- H. gronovii* L., Hairy hawkweed, occasional along Consumers Energy power line right-of-way trail remnant oak openings understory, *Gilbert* 49290, 49337, *Miller* 91.
- H. longipilum* Torr., Prairie hawkweed, disturbed oak-hickory forest near old Wattles Rd. entrance, *Gilbert* 49291. No recent observation.
- **Hypochaeris radicata* L., Cat's-ear, Consumers Energy power line right-of-way remnant oak openings understory, *Miller* 93, 122.
- Krigia biflora* (Walter) S. F. Blake, False dandelion, locally common in oak-hickory forest on N side of property, *Gilbert* 49108, *Miller* 180.
- K. virginica* (L.) Willd., Dwarf dandelion, NW entrance sandy field, *Gilbert* 49207. No recent observation.
- Lactuca biennis* (Moench) Fernald, Tall blue lettuce, low woodlands W of central esker, *Gilbert* 49495, 50159. No recent observation.
- L. canadensis* L., Wild lettuce, occasional in oak-hickory forest on esker, *Gilbert* 49322. Recent observation.
- L. serriola* L., Prickly lettuce, hillsides and low ground extreme SW portion of preserve, *Gilbert* 5093, 50166. No recent observation.
- Leucanthemum vulgare* Lam., Ox-eye daisy, occasional on Consumers Energy power line right-of-way remnant oak openings understory, *Gilbert* 49217. Recent observation.
- Liatis aspera* Michx., Rough blazing-star, occasional on Consumers Energy power line right-of-way remnant oak openings understory, *Gilbert* 50130, *Miller* 251.
- L. aspera* Michx. f. *benkei*, Rough blazing-star, uncommon on Consumers Energy power line right-of-way remnant oak openings understory, *Miller* 255.
- L. cylindracea* Michx., Cylindrical blazing-star, uncommon on Consumers Energy power line right-of-way remnant oak openings understory, *Gilbert* 50168. Recent observation.
- L. spicata* (L.) Willd., Marsh blazing-star, prairie fen near Hall Lake, *Gilbert* 49394, 50108. Recent observation.
- Packera aurea* (L.) Á. Löve & D. Löve, Golden ragwort, common in damp, low forest swamps, *Gilbert* 49107. Recent observation.
- **P. paupercula* (Michx.) Á. Löve & D. Löve, Northern ragwort, uncommon on W side of Hall Lake on wet margin of prairie fen, *Miller* 143.
- Prenanthes alba* L., White lettuce, wooded slopes of Brigham esker, *Gilbert* 49433, 49450. No recent observation.
- Ratibida pinnata* (Vent.) Barnhart, Yellow coneflower, hill just above the bog N side of north swamp, *Gilbert* 49397, 50147. No recent observation.
- Rudbeckia hirta* L., Black-eyed Susan, occasional on Consumers Energy power line right-of-way remnant oak openings understory, *Gilbert* 49202. Recent observation.
- R. fulgida* Aiton, Showy coneflower, moist ground on N side of outlet to Hall Lake, *Gilbert* 49403. No recent observation.
- **R. triloba* L., Three-lobed coneflower, locally common in disturbed oak-hickory forest near Arlington entrance, *Miller* 265.
- Solidago canadensis* L., Canada goldenrod, east edge of Hall Lake in sandy disturbed area, *Gilbert* 49468, *Miller* 6, *Skean* 5029.
- S. caesia* L., Bluestem goldenrod, common in oak-hickory forest, *Gilbert* 49472. Recent observation.

- S. juncea* Aiton, Early goldenrod, margin of remnant oak openings understory and oak-hickory forest, *Gilbert 49353*. Recent observation.
- S. nemoralis* Aiton, Gray goldenrod, occasional on Consumers Energy power line right-of-way remnant oak openings understory, *Miller 252*.
- **S. ohioensis* Riddell, Ohio goldenrod, occasional in prairie fen near Hall Lake, *Miller 267*.
- **S. patula* Muhl., Rough-leaved goldenrod, east edge of Hall Lake on wet margin of prairie fen, *Miller 4, 274*.
- **S. riddellii* Frank, Riddell's goldenrod, east edge of Hall Lake on wet margin of prairie fen, *Miller 5*.
- S. speciosa* Nutt., Showy goldenrod, common on Consumers Energy power line right-of-way remnant oak openings understory, *Gilbert 49355*. Recent observation.
- **S. uliginosa* Nutt., Bog goldenrod, prairie fen near Hall Lake, *Miller 273*.
- Symphotrichum cordifolium* (L.) G. L. Nesom, Heart-leaved aster, uncommon in disturbed oak-hickory forest near remnant prairie, *Miller 278*.
- S. lanceolatum* (Willd.) G. L. Nesom, Panicked aster, east edge of Hall Lake on wet margin of prairie fen and occasional on Consumers Energy power line right-of-way remnant oak openings understory, *Miller 3, 254*.
- S. lanceolatum* x *lateriflorum* (L.) Á. Löve & D. Löve, border of swamp at Hall Lake, *Gilbert 50171*. No recent observation.
- S. lateriflorum* (L.) Á. Löve & D. Löve, Calico aster, east edge of Hall Lake in sandy disturbed area, *Miller 2, 268*.
- S. pilosum* (Willd.) G. L. Nesom, Frost aster, common on Consumers Energy power line right-of-way remnant oak openings understory, *Miller 253, 276*.
- **S. puniceum* (L.) Á. Löve & D. Löve, Swamp aster, uncommon in boggy area on N side of Brigham Lake and locally common on Consumers Energy power line right-of-way remnant oak openings understory, *Miller 184, 259*.
- Taraxacum officinale* F. H. Wigg.**, Common dandelion, common on Consumers Energy power line right-of-way remnant oak openings understory, *Gilbert 4633*. Recent observation.
- Tragopogon dubius* Scop.**, Goat's beard, occasional on Consumers Energy power line right-of-way remnant oak openings understory, *Gilbert 49156*. Recent observation.
- Vernonia missurica* Raf., Missouri ironweed, border of pond at end of power line right-of-way, *Gilbert 49408, 49487, 50162*. Recent observation.

BALSAMINACEAE

- Impatiens capensis* Meerb., Spotted touch-me-not, common in southern hardwood swamp, *Gilbert 49364, 49423*. Recent observation.

BERBERIDACEAE

- Berberis thunbergii* DC.**, Japanese barberry, occasional in hardwood swamp, *Gilbert 50115, Miller 12*.
- Podophyllum peltatum* L., May-apple, locally common in oak-hickory forest, *Gilbert 49183*. Recent observation.

BETULACEAE

- Betula alleghaniensis* Britton, Yellow birch, common in hardwood swamp, *Gilbert 49447, 5050*. Recent observation.
- B. pumila* L., Bog birch, Common in prairie fen, *Gilbert 54028*. Recent observation.
- Carpinus caroliniana* Walter, Hornbeam, common in hardwood swamp, *Gilbert 49179, 50109*. Recent observation.
- Corylus americana* Walter, Hazelnut, common on Consumers Energy power line right-of-way, *Gilbert 49236*. Recent observation.

BIGNONIACEAE

- Catalpa speciosa*** Warder, Northern catalpa, occasional near Arlington entrance in disturbed oak-hickory forest, *Miller 105*.

BORAGINACEAE

- Hackelia virginiana* (L.) I. M. Johnst., Beggar's lice, common in hardwood swamp W of east esker, *Gilbert 50128, Miller 205*.

Lithospermum canescens (Michx.) Lehm., Hoary puccoon, occasional on eskers in oak-hickory forest, *Gilbert* 49132, 49171, 4969. No recent observation.

L. caroliniense (Walter) MacMill subsp. *croceum* (Fernald) Cusick., Hairy puccoon, locally common on Consumers Energy power line right-of-way in remnant oak openings understory, *Gilbert* 5029, 49171. Recent observation.

BRASSICACEAE

**Alliaria petiolata* (M. Bieb.) Cavara & Grande, Garlic mustard, common in oak-hickory forest throughout property near trails, *Miller* 21, 107, *Skean* 5008.

Barbarea vulgaris R. Br., Yellow rocket, in low wet soil between Brigham and central eskers, *Gilbert* 4990. Recent observation.

Berteroa incana (L.) DC., Hoary alyssum, common along Consumers Energy power line right-of-way remnant oak openings understory, *Miller* 52.

Boechera canadensis (L.) Al-Shehbaz, Sickle-pod, under oaks on Brigham esker, *Gilbert* 5212. Recent observation.

Capsella bursa-pastoris (L.) Medik., Shepherd's purse, common on ridges, *Gilbert* 49120. No recent observation.

Cardamine bulbosa (Muhl.) Britton, Sterns & Poggenb., Spring cress, around margin of Hall Lake and frequent in low, wet land, *Gilbert* 4983, 4984, 5022. Recent observation.

C. pratensis L., Cuckoo-flower, boggy margin of Brigham Lake, *Gilbert* 4939, 4982. No recent observation.

**Hesperis matronalis* L., Dame's rocket, common in disturbed oak-hickory forest near Arlington entrance, *Skean* 5007.

**Lepidium campestre* (L.) R. Br., Field cress, common near Arlington parking lot in disturbed oak-hickory forest, *Miller* 46.

L. virginicum L., Common peppergrass, locally common along Consumers Energy power line right-of-way remnant oak openings understory, *Gilbert* 49121, 49162, *Miller* 101.

**Nasturtium officinale* R. Br., Watercress, edge of outlet to Hall Lake near SW corner of preserve, *Gilbert* 49318. No recent observation.

Rorippa palustris (L.) Besser subsp. *hispida* (Desv.) Jonsell, Yellow cress, occasional in boggy area around Brigham Lake, *Miller* 131, *Skean* 5009.

Sisymbrium altissimum L., Tumble mustard, sandy hill W side of preserve, *Gilbert* 5232. No recent observation.

BUXACEAE

**Pachysandra terminalis* Siebold & Zucc., Japanese spurge, isolated patch in oak-hickory woods near E boundary, near Peck Street, *Anderson* 001.

CAMPANULACEAE

Campanula aparinoides Pursh, Marsh bellflower, prairie fen near Hall Lake, *Gilbert* 49294. Recent observation.

C. rotundifolia L., Bluebell, Brigham esker on sandy soil in open second growth hardwood forest, *Gilbert* 49253, 49286. No recent observation.

Lobelia kalmii L., Kalm's lobelia, occasional in prairie fen near Hall Lake, *Gilbert* 49295. Recent observation.

L. siphilitica L., Great blue lobelia, prairie fen near Hall Lake, *Gilbert* 49406. Recent observation.

L. spicata Lam., Pale spiked lobelia, grass and sedge bog surrounding Hall Lake, *Gilbert* 49289a. No recent observation.

CANNABACEAE

Celtis occidentalis L., Hackberry, Locally common in hardwood swamp near Brigham boardwalk, *Gilbert* 49188, 5095. Recent observation.

CAPRIFOLIACEAE

**Dipsacus fullonum* L., Wild teasel, uncommon on Consumers Energy trail on remnant oak openings understory, *Miller* 212.

Lonicera × *bella* Zabel, Hybrid honeysuckle, uncommon near Arlington parking lot in oak-hickory forest, *Miller* 23.

L. dioica L., Glaucous honeysuckle, upland hardwood, extreme SE forested area, *Gilbert* 49280, 5057. No recent observation.

L. morrowii L., Morrow honeysuckle, uncommon near Arlington parking lot in oak-hickory forest, *Gilbert* 4975, *Miller* 25.

**Symphoricarpos orbiculatus* Moench, Coralberry, occasional on NW side of property in oak-hickory forest, *Miller* 141.

Triosteum aurantiacum E. P. Bicknell, Horse-gentian, open upland hardwood SE arm, *Gilbert* 49345. No recent observation.

Valeriana uliginosa (Torr. & A. Gray) Rydb., Swamp valerian, common in swamp around tamarack, *Gilbert* 4844, 49133. Recent observation.

CARYOPHYLLACEAE

Arenaria serpyllifolia L., Thyme-leaved sandwort, locally common along Consumers Energy power line right-of-way remnant prairie, *Gilbert* 49124. Recent observation.

Cerastium fontanum Baumg., Mouse-ear chickweed, disturbed area near Brownlee Park, *Gilbert* 49125, 5012. No recent observation.

Dianthus armeria L., Deptford pink, common along Consumers Energy power line right-of-way remnant oak openings understory, *Miller* 90.

Minuartia michauxii (Fenzl) Farw., Rock sandwort, common on sandy ridges, *Gilbert* 49126, 49216. No recent observation.

Paronychia canadensis (L.) Alph. Wood, Tall forked chickweed, open upland hardwood on central esker, *Gilbert* 49340. No recent observation.

Saponaria officinalis L., Bouncing bet, uncommon near Arlington parking lot and common along Consumers Energy power line right-of-way remnant oak openings understory, *Gilbert* 49308. Recent observation.

Silene dichotoma Ehrh., Forked catchfly, field bordering the second growth hardwood, *Gilbert* 49228, 49229, 5060. No recent observation.

S. latifolia Poir., White cockle, common along Consumers Energy power line right-of-way remnant oak openings understory, *Gilbert* 49230, 49426, 5059, *Miller* 89.

S. vulgaris (Moench) Garcke, Bladder campion, Consumers Energy power line right-of-way remnant oak openings understory, *Skean* 5016.

Stellaria graminea L., Starwort, locally common near Jameson parking lot in disturbed oak-hickory forest, *Miller* 48.

S. longifolia Willd., Long-leaved chickweed, north swamp near north esker N of Brigham Lake, *Gilbert* 49113. No recent observation.

S. media (L.) Vill., Common chickweed, locally common near Arlington entrance in oak-hickory forest, *Miller* 17.

CELASTRACEAE

**Celastrus orbiculatus* Thunb., Oriental bittersweet, common in disturbed oak-hickory forest and along edges of disturbed remnant oak openings understory, *Miller* 14.

C. scandens L., Climbing bittersweet, Hill above Dexter Lake, *Gilbert* 49170. No recent observation.

Euonymus alatus (Thunb.) Siebold, Winged euonymus, common in oak-hickory forest on E side of property, *Skean* 5011.

E. fortunei (Turcz.) Hand.-Mazz., Wintercreeper, occasional near Arlington entrance in disturbed oak-hickory forest, *Miller* 7.

E. obovatus Nutt., Running strawberry-bush, occasional in oak-hickory forest, *Gilbert* 501. Recent observation.

Parnassia glauca Raf., Grass-of-parnassus, common in bogs surrounding Hall Lake, *Gilbert* 49407. No recent observation.

CERATOPHYLLACEAE

Ceratophyllum demersum L., Coontail, slow stream draining Hall Lake, *Gilbert* 5256. No recent observation.

CISTACEAE

Crocanthemum bicknellii (Fernald) Janch., Frostweed, common on dry sandy field on Dexter esker, *Gilbert* 50153. No recent observation.

C. canadense (L.) Britton, Common frostweed, W side of hill above Dexter Lake, *Gilbert* 49157. No recent observation.

Lechea mucronata Raf., Hairy pinweed, dry open sandy soil on hill W of north swamp, *Gilbert* 49393. No recent observation.

COMMELINACEAE

Tradescantia ohiensis Raf., Common spiderwort, common on Consumers Energy power line right-of-way remnant oak openings understory, *Gilbert* 49166. Recent observation.

CONVALLARIACEAE – SEE ASPARAGACEAE

CONVOLVULACEAE

***Convolvulus arvensis* L.**, Field bindweed, weedy grassy pasture just E of SE arm of preserve, *Gilbert* 4935. No recent observation.

CORNACEAE

Cornus alternifolia L., Alternate-leaved dogwood, occasional in oak-hickory forest, *Gilbert* 49140. Recent observation.

C. amomum Mill. subsp. *obliqua* (Raf.) J. S. Wilson, Pale dogwood, In W swamp, *Gilbert* 5089. No recent observation.

C. florida L., Flowering dogwood, occasional in oak-hickory forest, *Gilbert* 4962. Recent observation.

C. foemina Mill. subsp. *racemosa* (Lam.) J.S. Wilson, Gray dogwood, occasional near Jame-son parking lot in disturbed oak-hickory forest, *Gilbert* 49106, 49168, *Miller* 47.

C. sericea L., Red-osier, locally common near swamp adjacent to oak openings understory, *Gilbert* 49105. Recent observation.

CYPERACEAE

**Carex alata* T. & G., Winged sedge, near pond at beginning of power line right-of-way and locally common along border of Hall Lake on wet margin of prairie fen, *Miller* 66, 110, 231.

**C. bebbii* (L. H. Bailey) Fernald, Sedge, locally common in boggy area surrounding Brigham Lake, *Miller* 130, 223. *C. blanda* Dewey, Sedge, along esker trail in oak-hickory forest and wet margin of Brigham Lake, *Miller* 30, 42.

C. comosa Boott, Sedge, common along border of Hall Lake on wet margin of prairie fen, *Gilbert* 49262. Recent observation.

C. cephalophora Willd., Sedge, along esker trail in oak-hickory forest, *Miller* 32, 34.

C. gracillima Schwein., Sedge, along esker trail in oak-hickory forest, *Gilbert* 49144, *Miller* 28.

C. grayi J. Carey, Sedge, Rare in hardwood swamp S of Brigham Lake, *Miller* 280.

C. hystericina Willd., Sedge, Locally common in boggy area surrounding Brigham Lake and on N side of Hall Lake in wet margin of prairie fen, *Gilbert* 49145, *Miller* 38, 147.

**C. interior* L. H. Bailey, Sedge, boggy area around Brigham Lake, *Miller* 41.

C. lasiocarpa Ehrh., Sedge, Occasional along border of Hall Lake on wet margin of prairie fen, *Miller* 109.

**C. leptalea* Wahlenb., Sedge, boggy area around Brigham Lake, *Miller* 43.

C. pensylvanica Lam., Sedge, Along Consumers Energy power line right-of-way remnant oak openings understory, *Gilbert* 4950, *Miller* 72.

C. prairea Dewey, Sedge, occasional on N side of Hall Lake on wet margin of prairie fen, *Miller* 149.

C. rosea Willd., Curly-styled wood sedge, along esker trail in oak-hickory forest, *Miller* 29, 35.

C. scoparia Willd., Sedge, border of N swamp, *Gilbert* 49266. No recent observation.

C. stipata Willd., Sedge, locally common in southern hardwood swamp, *Gilbert* 49143, *Miller* 37.

C. stricta Lam., Sedge, occasional on E side of Hall Lake on wet margin of prairie fen, *Miller* 164.

C. swanii (Fernald) Mack., Sedge, locally common near ponds near power line right-of-way, *Miller* 67, 221, 228.

- C. viridula* Michx., Sedge, occasional on E side of Hall Lake on wet margin of prairie fen, *Gilbert 49174, Miller 162.*
- C. vulpinoidea* Michx., Sedge, locally common at beginning of Consumers Energy trail on remnant oak openings understory, *Gilbert 49215, Miller 121.*
- Cladium mariscoides* (Muhl.) Torr., Sedge, locally common on E side of Hall Lake on wet margin of prairie fen, *Miller 156.*
- Cyperus lupulinus* (Spreng.) Marcks, Slender sand sedge, locally common on NW side of property in oak-hickory forest, *Gilbert 49309, Miller 139.*
- C. strigosus* L., Long scaled nut sedge, Brigham Lake aquatic, *Gilbert 49499, Miller 238, 239.*
- Eleocharis erythropoda* Steud., Spike-rush, common in wet margin of prairie fen surrounding Hall Lake and on NE side of Brigham Lake in boggy area, *Miller 40, 148, 186, 194.*
- E. palustris* (L.) Roem. & Schult., Spike-rush, common in boggy area around Brigham Lake and prairie fen near Hall Lake, *Gilbert 49263.* No recent observation.
- E. rostellata* (Torr.) Torr, Spike-rush, common in prairie fen and on NE side of Brigham Lake in boggy area, *Miller 158, 198.*
- Eriophorum viridi-carinatum* (Engelm.) Fernald, Green-keeled cotton grass, bog areas around Hall and Brigham Lake, *Gilbert 54003.* No recent observation.
- Schoenoplectus acutus* (Bigelow) Á. Löve & D. Löve, Hardstem bulrush, common in wet margin of prairie fen around Hall Lake, *Gilbert 4928.* Recent observation.
- S. pungens* (Vahl) Palla, Threesquare, locally common on border of Hall Lake on wet margin of prairie fen, *Gilbert 5040, 54057. Miller 108.*
- S. subterminalis* (Torr.) Soják, Bulrush, near outlet of Brigham Lake, *Gilbert 52101.* No recent observation.
- S. tabernaemontani* (C. C. Gmel.) Palla, Softstem bulrush, common along border of Hall Lake on wet margin of prairie fen, *Miller 113, 114, 146.*
- Scirpus atrovirens* Willd., Bulrush, locally common in boggy area on N side of Brigham Lake, *Gilbert 49234, Miller 128, 183.*
- S. cyperinus* (L.) Kunth, Wool-grass, locally common on wet margin of pond at end of power line right-of-way, *Miller 217.*
- **Scleria verticillata* Willd., Nut-rush, prairie fen near Hall Lake, *Miller 270.*

DIOSCOREACEAE

- Dioscorea villosa* L., Wild yam, oak-hickory forest, *Gilbert 49320.* Recent observation.

DIPSACACEAE – SEE CAPRIFOLIACEAE

DROSERACEAE

- Drosera rotundifolia* L., Round-leaved sundew, occasional in prairie fen, *Gilbert 49419.* Recent observation.

ELAEAGNACEAE

- Elaeagnus umbellata* Thunb.**, Autumn-olive, occasional on Consumers Energy power line right-of-way remnant oak openings understory, *Skean 5013.*

ERICACEAE

- Chamaedaphne calyculata* (L.) Moench, Leatherleaf, rare in west swamp, *Gilbert 5063.* No recent observation.
- Gaultheria procumbens* L., Teaberry, on highland surrounded by swamp on W side of preserve, *Gilbert 481, 49494.* No recent observation.
- Monotropa uniflora* L., Indian-pipe, occasional in upland oak forests and uncommon along Consumers Energy power line right-of-way trail remnant oak openings understory, *Gilbert 49471.* Recent observation.
- Pyrola asarifolia* Michx., Pink pyrola, under Tamarack in bog surrounding Brigham Lake, *Gilbert 5033.* No recent observation.
- P. elliptica* Nutt., Large-leaved shinleaf, uncommon in boggy area near swamp on N side of property, *Gilbert 49194, 5048.* Recent observation.
- Vaccinium corymbosum* L., Highbush blueberry, Sphagnum area about Brigham Lake and N edge of W swamp, *Gilbert 4966, 4973, 4973b, 49281, Skean 5032.*

V. myrtilloides Michx., Velvetleaf blueberry, in sandy oak-hickory forest just N of W swamp, Gilbert 4963, 5067, Skean 5033, 5033.

V. pallidum Aiton, Dryland blueberry, common in sandy soil along roadway near Brownlee Park, Gilbert 5066. No recent observation.

EUPHORBIACEAE

Euphorbia corollata L., Flowering spurge, occasional along Consumers Energy power line right-of-way trail remnant oak openings understory, Gilbert 49201, Miller 175.

**E. cyparissias* L., Cypress spurge, locally common near Jameson parking lot in disturbed oak openings understory, Miller 50, 115.

E. maculata L., Spotted spurge, common along Dexter esker, Gilbert 50154. No recent observation.

FABACEAE

Amorpha canescens Pursh, Lead-plant, uncommon on Consumers Energy power line right-of-way remnant oak openings understory, Gilbert 49233, 5047. Recent observation.

Amphicarpaea bracteata (L.) Fernald, Hog-peanut, common in low areas and woodlands, Gilbert 49501. No recent observation.

Apios americana Medik., Indian-potato, at base of Dexter Lake esker near Hall Lake, Gilbert 49324. Recent observation.

Desmodium canadense (L.) DC., Showy tick-trefoil, locally common in remnant oak openings understory along Consumers Energy power line right-of-way, Gilbert 49333, 50110, Skean 5023.

**D. ciliare* (Willd.) DC., Hairy tick-trefoil, locally common on Consumers Energy power line right-of-way in remnant oak openings understory, Gilbert 5022, Miller 216.

**D. cuspidatum* (Willd.) Loud., Smooth-bracted tick-trefoil, common along Consumers Energy power line right-of-way in remnant oak openings understory, Gilbert 49198, 49255, Miller 226.

D. illinoense A. Gray, Prairie tick-trefoil, occasional on Consumers Energy power line right-of-way remnant oak openings understory, Gilbert 4931. Recent observation.

D. marilandicum (L.) DC., Small-leaved tick-trefoil, sandy field adjacent to the lane leading in from Wattles Rd., Gilbert 50139. No recent observation.

D. paniculatum (L.) DC., Panicked tick-trefoil, second growth hardwood on second slope of Brigham esker, Gilbert 49438. No recent observation.

**D. perplexum* B. G. Schub., Tick-trefoil, occasional on Consumers Energy power line right-of-way remnant oak openings understory, Skean 5014.

D. sessilifolium (Torr.) Torr. & A. Gray, sessile-leaved tick-trefoil, locally common on Consumers Energy power line right-of-way in remnant oak openings understory, Gilbert 50138, Skean 5015, 5024.

Hylodesmum glutinosum (Willd.) H. Ohashi & R. R. Mill, Clustered-leaved tick-trefoil, locally common on NW side of property in oak-hickory forest, Miller 138.

H. nudiflorum (L.) H. Ohashi & R. R. Mill, Naked tick-trefoil, sandy esker beneath second growth hardwood, Gilbert 49302. No recent observation.

Lathyrus ochroleucus Hook., Pale vetchling, fairly frequent along eskers, Gilbert 5021. No recent observation.

**L. latifolius* L., Sweet pea, rare in oak-hickory forest on NW side of property near oak openings understory border, Miller 134.

L. palustris L., Marsh pea, infrequent in bog around Brigham Lake, Gilbert 49187, 49239. No recent observation.

L. venosus Willd., Veiny pea, infrequent on eskers, Gilbert 49117, 5030. No recent observation.

Lespedeza capitata Michx., Round-headed bush-clover, locally common on Consumers Energy power line right-of-way in remnant oak openings understory, Gilbert 49452, 49453. Recent observation.

L. hirta (L.) Hornem., Hairy bush-clover, locally common on Consumers Energy power line right-of-way in remnant oak openings understory, Gilbert 49409, 49453, 49462. Recent observation.

- L. × nuttallii* Darl., bushclover, sandy soil along road leading in from Brownlee Park entrance, *Gilbert 49461*. No recent observation.
- **Lotus corniculatus* L., Birdfoot trefoil, locally common near Jameson parking lot in disturbed oak openings understory, *Miller 51, 116*.
- Lupinus perennis* L., Wild lupine, near top of main esker above Hall Lake, *Gilbert 4987*. No recent observation.
- Medicago lupulina* L., Black medick, locally common near Jameson parking lot near remnant oak openings understory, *Gilbert 51002*. Recent observation.
- Melilotus albus* Medik., White sweet-clover, locally common near Jameson entrance in remnant oak openings understory, *Gilbert 49276*. Recent observation.
- M. officinalis* (L.) Pall., Yellow sweet-clover, occasional along Consumers Energy power line right-of-way remnant oak openings understory, *Gilbert 49196*. Recent observation.
- Robinia pseudoacacia* L., Black locust, occasional in oak-hickory forest on NW side of property, *Gilbert 54015*. Recent observation.
- Securigera varia* (L.) Lassen, Crown-vetch, locally common near Arlington parking lot, *Miller 103*.
- Tephrosia virginiana* (L.) Pers., Goat's-rue, along entrance road from Brownlee Park, *Gilbert 49205, 49247*. No recent observation.
- **Trifolium arvense* L., Rabbitfoot clover, locally common along Consumers Energy power line right-of-way remnant oak openings understory, *Miller 87, 133*.
- T. aureum* Pollich, Hop clover, along road leading in from Brownlee Park, *Gilbert 5042*. No recent observation.
- T. campestre* Schreb., Low hop clover, common along Consumers Energy power line right-of-way remnant oak openings understory, *Miller 58*.
- T. pratense* L., Red clover, common near Arlington and Jameson disturbed forest entrance, *Gilbert 5043*. Recent observation.
- T. repens* L., White clover, common near Arlington and Jameson disturbed forest entrances, *Gilbert 5032*. Recent observation.
- Vicia americana* Willd., American vetch, base of W side of hill above Dexter Lake, *Gilbert 49167*. No recent observation.
- V. caroliniana* Walter, Pale vetch, common on eskers, *Gilbert 4968*. No recent observation.
- **V. sativa* L., Common vetch, occasional along Consumers Energy power line right-of-way trail remnant oak openings understory, *Miller 85*.
- V. villosa* Roth, Hairy vetch, sandy field along road from Brownlee Park, *Gilbert 49153, 49209*. No recent observation.

FAGACEAE

- Fagus grandifolia* Ehrh., American beech, common in oak-hickory forest, *Gilbert 49444*. Recent observation.
- Quercus alba* L., White oak, common in oak-hickory forest, *Gilbert 5018, 5010*. Recent observation.
- **Q. ellipsoidalis* E. J. Hill, Hill's oak, occasional along Consumers Energy power line right-of-way trail remnant oak openings understory, *Gilbert 50150, Miller 174*.
- Q. imbricaria* Michx., Shingle oak, along road leading in from entrance to Brownlee Park, *Gilbert 508*. No recent observation.
- Q. rubra* L., Red oak, common in oak-hickory forest, *Gilbert 50151*. Recent observation.
- Q. velutina* Lam., Black oak, common in oak-hickory forest and on Consumers Energy power line right-of-way, *Gilbert 49489, 50149*. Recent observation.

GENTIANACEAE

- Bartonia virginica* (L.) Britton, Sterns, & Poggenb., Screw-stem, dry woods on W side of preserve, *Gilbert 52114*. No recent observation.
- Gentianopsis virgata* (Raf.) Holub, Small fringed gentian, occasional in prairie fen on E side of Hall Lake, *Gilbert 49508*. Recent observation.

GERANIACEAE

- Geranium maculatum* L., Wild geranium, common in oak-hickory forest, *Gilbert 49111*. Recent observation.

GROSSULARIACEAE

Ribes americanum Mill., Wild black currant, swamp W of Hall and central esker, *Gilbert* 4946, 50107. No recent observation.

R. cynosbati L., Wild gooseberry, occasional in oak-hickory forest, *Gilbert* 5058. Recent observation.

HALORAGACEAE

Myriophyllum heterophyllum Michx., Various-leaved water-milfoil, Brigham Lake submerged aquatic, *Miller* 235.

M. sibiricum Komarov, Spiked water-milfoil, Brigham Lake submerged aquatic, *Gilbert* 5291, *Miller* 236A.

M. verticillatum L., Water-milfoil, Brigham Lake submerged aquatic, *Miller* 234, 236B.

HEMEROCALLIDACEAE – SEE ASPHODELACEAE

HYDRANGEACEAE

**Philadelphus coronarius* L., Sweet mock-orange, uncommon near Arlington parking lot in oak-hickory forest, *Miller* 24.

**P. inodorus* L., Mock-orange, uncommon along Consumers Energy power line right-of-way in remnant oak openings understory, *Miller* 88.

HYDROCHARITACEAE

Elodea canadensis Michx., Common waterweed, locally common in prairie fen and in Hall Lake, *Miller* 166, 243.

Najas flexilis (Willd.) Rostk. & Schmidt, Slender naiad, submerged in Brigham Lake, *Gilbert* 5295. No recent observation.

**N. marina* L., Spiny naiad, locally common in Hall Lake fen, *Miller* 193, 245.

HYPERICACEAE

Hypericum boreale (Britt.) E.P. Bicknell, Northern St. John's-wort, uncommon on W side of Hall Lake on wet margin of prairie fen, *Miller* 229.

H. perforatum L., Klamath weed, common in prairie fen, *Gilbert* 49200. Recent observation.

H. prolificum L., Shrubby St. John's-wort, central esker near its N end, *Gilbert* 49341, 49371. No recent observation.

H. punctatum Lam., Spotted St. John's-wort, east swamp, *Gilbert* 49359, 50124. No recent observation.

Triadenum fraseri (Spach) Gleason, Marsh St. John's-wort, west swamp, *Gilbert* 5081. No recent observation.

HYPOXIDACEAE

Hypoxis hirsuta (L.) Coville, Star-grass, wetlands around lakes, *Gilbert* 49131. Recent observation.

IRIDACEAE

Iris virginica L., Southern blue flag, uncommon on wet margin of Hall Lake in boggy area, *Gilbert* 49175, 54014. Recent observation.

Sisyrinchium albidum Raf., Common blue-eyed-grass, dry sandy soil of esker under second growth hardwood, *Gilbert* 49100, 5020. No recent observation.

JUGLANDACEAE

Carya glabra (Mill.) Sweet, Pignut hickory, common in oak-hickory forest and on Consumers Energy power line right-of-way, *Gilbert* 49483, 49338. Recent observation.

C. ovata (Mill.) K. Koch, Shagbark hickory, occasional in oak-hickory forest, *Gilbert* 4989. Recent observation.

Juglans nigra L., Black walnut, base of hill W of outlet to Hall Lake, *Gilbert* 49319. Recent observation.

JUNCACEAE

**Juncus dudleyi* Wiegand, Dudley's rush, occasional on N side of Hall Lake on wet margin of prairie fen, *Miller* 151.

J. effusus L., Soft-stemmed rush, locally common near ponds along power line right-of-way, *Miller* 64, 224.

J. tenuis Willd., Path rush, locally common on Consumers Energy trail on remnant oak openings understory, *Gilbert 49214, Miller 120*.

Luzula multiflora (Ehrh.) Lej., Common wood rush, locally common in oak-hickory forest on N side of property, *Gilbert 51005, Miller 75, 123*.

JUNCAGINACEAE

Triglochin palustris L., Slender bog arrow-grass, occasional E of Hall Lake on prairie fen, *Gilbert 5034, Miller 195*.

LAMIACEAE

Blephilia ciliata (L.) Benth., Ohio horse mint, open second growth hardwood on Brigham esker, *Gilbert 49252*. No recent observation.

Clinopodium vulgare (L.) Fritsch, Wild-basil, sandy soil at beginning of driveway to NE entrance from Wattles Rd., *Gilbert 49275*. No recent observation.

Glechoma hederacea L., Ground-ivy, occasional near Arlington entrance in disturbed oak-hickory forest, *Miller 16*.

Lamium purpureum L., Purple dead-nettle, occasional near Arlington entrance in disturbed oak-hickory forest, *Miller 15*.

Leonurus cardiaca L., Motherwort, occasional in oak-hickory forest on NW side of property, *Gilbert 49346*. Recent observation.

Lycopus uniflorus Michx., Northern bugle weed, margin of Dexter Lake, *Gilbert 50172, 54067*. No recent observation.

Mentha canadensis L., Wild mint, border of Dexter Lake, *Gilbert 54059*. No recent observation.

Monarda fistulosa L., Wild-bergamot, locally common along Consumers Energy power line right-of-way remnant oak openings understory, *Gilbert 49251, 49289*. Recent observation.

M. punctata L., Dotted mint, along Consumers Energy power line right-of-way, *Gilbert 49317*. Recent observation.

Nepeta cataria L., Catnip, locally common on Consumers Energy trail on remnant oak openings understory, *Gilbert 49350, Miller 214*.

Prunella vulgaris L., Heal-all, oak-hickory forest on NW side of preserve, *Gilbert 49206, 49250, 49327*. Recent observation.

Pycnanthemum virginianum (L.) Durand & Jackson, Common mountain mint, locally common in boggy area on W side of Hall Lake, *Gilbert 49323, 49360*. Recent observation.

Scutellaria galericulata L., Marsh skullcap, occasional E of Hall Lake on prairie fen, *Gilbert 49245, 49246, 49367, 49270, 49271, 49368, 5072; Miller 196*.

S. lateriflora L., Mad-dog skullcap, central esker on border of west swamp, *Gilbert 5275*. No recent observation.

LAURACEAE

Lindera benzoin (L.) Blume, Spicebush, common in hardwood swamp, *Gilbert 4926, 49189*. Recent observation.

Sassafras albidum (Nutt.) Nees, Sassafras, common in oak-hickory forest on NW side of property, *Gilbert 49180*. Recent observation.

LENTIBULARIACEAE

Utricularia cornuta Michx., Horned bladderwort, prairie fen near Hall Lake, *Gilbert 49278, 5044, Miller 155*.

U. intermedia Hayne, Flat-leaved bladderwort, shallow puddles on margin of Brigham Lake, *Gilbert 4992*. No recent observation.

U. vulgaris L., Common bladderwort, Hall Lake submerged aquatic, *Gilbert 49260, 5290, Miller 242*.

LILIACEAE

Lilium michiganense Farw., Michigan lily, base of eskers near outlet to Hall Lake, *Gilbert 49330*. No recent observation.

LYTHRACEAE

Lythrum salicaria L., Purple loosestrife, locally common in hardwood swamp surrounding Brigham boardwalk, *Miller 189*.

MALVACEAE

Tilia americana L., Basswood, locally common in southern hardwood swamp. *Gilbert* 49181, *Miller* 36.

MELANTHIACEAE

Anticlea elegans (Pursh) Rydb., White camas, common in bogs around lakes, *Gilbert* 49328, 50112. Recent observation.

Triantha glutinosa (Michx.) Baker, False asphodel, grass and sedge bog surrounding Hall Lake, *Gilbert* 49420, 50113. No recent observation.

Trillium grandiflorum (Michx.) Salisb., Common trillium, uncommon in hardwood swamp W of east esker, *Miller* 208.

MENISPERMACEAE

Menispermum canadense L., Moonseed, uncommon in oak-hickory forest N of Brigham Lake, *Gilbert* 49173, *Miller* 127.

MORACEAE

Morus alba L., White mulberry, occasional near Arlington entrance in disturbed oak-hickory forest, *Miller* 153.

MYRSINACEAE – SEE PRIMULACEAE

NYCTAGINACEAE

**Mirabilis nyctaginea* (Michx.) MacMill., Wild four-o'clock, uncommon along Consumers Energy power line right-of-way in remnant oak openings understory, *Miller* 118.

NYMPHAEACEAE

Nuphar advena (Aiton) W. T. Aiton, Yellow pond-lily, common in and near Hall and Brigham Lake, *Gilbert* 49147, 54025. Recent observation.

**N. variegata* Durand, Yellow pond-lily, Brigham Lake, *Gilbert* 54024. No recent observation.

Nymphaea odorata Aiton, Sweet-scented waterlily, common in and near Hall and Brigham Lake, *Gilbert* 49283. Recent observation.

OLEACEAE

Fraxinus americana L., White ash, deep woods SE of Brigham Lake, *Gilbert* 49446. No recent observation.

F. nigra Marshall, Black ash, common E of esker trail in hardwood swamp, *Miller* 169.

**F. pennsylvanica* Marshall, Green ash, common E of esker trail in hardwood swamp. 1m tall tree, *Miller* 168.

**Ligustrum obtusifolium* Siebold & Zucc., Border privet, occasional along Consumers Energy power line right-of-way trail remnant oak openings understory, *Miller* 99.

ONAGRACEAE

Circaea alpina L., Small enchanter's-nightshade, in low area W of middle esker, *Gilbert* 49244. No recent observation.

C. canadensis (L.) Hill, Enchanter's-nightshade, common in hardwood swamp and occasional in oak-hickory forest, *Gilbert* 49243. Recent observation.

Epilobium coloratum Biehler, Cinnamon willow-herb, swampy area on E border of preserve, *Gilbert* 49428. No recent observation.

**E. hirsutum* L., Great hairy willow-herb, occasional in dried up swamp on N side of property, *Miller* 177.

E. leptophyllum Raf., Fen willow-herb, swampy bog adjacent to road leading in from Brownlee Park entrance, *Gilbert* 49361. No recent observation.

E. strictum Spreng., Downy willow-herb, swampy bog adjacent to road leading in from Brownlee Park entrance, *Gilbert* 49362, 54055. No recent observation.

Oenothera biennis L., Common evening-primrose, Consumers Energy power line right-of-way, *Gilbert* 49311. Recent observation.

O. clelandii W. Dietr., P.H. Raven, & W.L. Wagner, Long-spiked evening-primrose, sandy weedy grassy pasture bordering W side of preserve, *Gilbert* 49313. No recent observation.

O. villosa Thunb., Evening-primrose, Brigham esker just above Brigham Lake in relatively dry sandy soil, *Gilbert* 49344. No recent observation.

ORCHIDACEAE

- Calopogon tuberosus* (L.) Britton, Sterns & Poggenb., Grass-pink, occasional in prairie fen on NE side of Dexter Lake, *Gilbert 49186*. Recent observation.
- Corallorhiza maculata* Raf., Spotted coral-root, oak woods on hill E of Brigham Lake, *Gilbert 50163*. No recent observation.
- Cypripedium acaule* Aiton, Pink lady-slipper, near SE margin of Brigham Lake, *Gilbert 4843, 4991*. No recent observation.
- C. candidum* Willd., White lady-slipper, uncommon in prairie fen on S side of Hall Lake, *Gilbert 4842*. No recent observation. Last seen by the second author in ca. 2001.
- C. parviflorum* Salisb. var. *pubescens* (Willd.) O. W. Knight, Yellow lady-slipper, lowland deep forest E of Brigham Lake, *Gilbert 4841*. No recent observation.
- C. reginae* Walter, Showy lady-slipper, bog N of Brigham Lake, *Gilbert 4615, 49184*. No recent observation. Last seen by the second author in ca. 2003.
- Platanthera clavellata* (Michx.) Luer, Club-spur orchid, rich low woodlands S of Brigham Lake, *Gilbert 50103*. No recent observation.
- **P. aquilonis* Sheviak, Green orchid, bog surrounding Dexter Lake, *Gilbert 5046*. No recent observation.
- Pogonia ophioglossoides* (L.) Ker Gawl., Rose pogonia, bog surrounding Dexter Lake and in marsh surrounding Brigham Lake, *Gilbert 49277, 5045, 54103*. Recent observation.
- Spiranthes romanzoffiana* Cham., Hooded ladies'-tresses, grass and sedge bog around Hall Lake, *Gilbert 49421*. No recent observation.

OROBANCHACEAE

- Agalinis purpurea* (L.) Pennell, Purple false foxglove, prairie fen near Hall Lake, *Gilbert 49442, Miller 272*.
- Aureolaria flava* (L.) Farw., Smooth false foxglove, sandy soil under second growth hardwood near Brigham esker, *Gilbert 49422*. No recent observation.
- Pedicularis canadensis* L., Wood-betony, on ridges particularly near their base, *Gilbert 49134*. No recent observation.
- P. lanceolata* Michx., Swamp-betony, wet lowland bordering outlet to Hall Lake, *Gilbert 49411*. No recent observation.

OXALIDACEAE

- Oxalis dillenii* Jacq., Common yellow wood-sorrel, locally common in oak-hickory forest on N side of property, *Miller 76*.
- O. stricta* L., Yellow wood-sorrel, occasional along Consumers Energy power line right-of-way, *Gilbert 49220*. Recent observation.

PAPAVERACEAE

- Sanguinaria canadensis* L., Bloodroot, near base of main esker in oak-hickory forest, *Gilbert 4927*. Recent observation.

PARNASSIACEAE – SEE CELASTRACEAE

PENTHORACEAE

- Penthorum sedoides* L., Ditch stonecrop, rare in north swamp, *Gilbert 49477*. No recent observation.

PHRYMACEAE

- Mimulus ringens* L., Monkey-flower, uncommon in boggy area on NE side of Brigham Lake, *Miller 185*.
- Phryma leptostachya* L., Lopseed, locally common on NW side of property in oak-hickory forest, *Gilbert 49349, 5053, Miller 137*.

PHYTOLACCACEAE

- Phytolacca americana* L., Pokeweed, disturbed oak-hickory forest, *Gilbert 49347*. Recent observation.

PLANTAGINACEAE

- Chelone glabra* L., Turtlehead, grass and sedge bog around Hall Lake, *Gilbert 49506*. No recent observation.

- Nuttallanthus canadensis* (L.) D. A. Sutton, Blue toadflax, along roadside in reforested area on hill W of north swamp, *Gilbert* 5025. No recent observation.
- Penstemon hirsutus* (L.) Willd., Hairy beard-tongue, common on Consumers Energy power line right-of-way remnant oak openings understory, *Gilbert* 49116, 49154, *Miller* 62.
- Plantago aristata* Michx., Bracted plantain, sandy soil bordering driveway into preserve from Wattles Rd., *Gilbert* 49425. No recent observation.
- P. lanceolata* L., Ribgrass, common along Consumers Energy power line right-of-way trail, *Gilbert* 49163. Recent observation.
- P. rugelii* Decne. Rugel's plantain, wet land between Brigham and central esker, *Gilbert* 49342, 49500. No recent observation.
- Veronica arvensis* L., Field speedwell, sandy ridges, *Gilbert* 49123. No recent observation.
- Veronicastrum virginicum* (L.) Farw., Culver's-root, Dexter esker under open second growth hardwoods, *Gilbert* 49303, 49326. No recent observation.

POACEAE

- Agrostis gigantea* Roth, Redtop, occasional on E side of Hall Lake on wet margin of prairie fen, *Miller* 161.
- **A. stolonifera* L., Creeping bent, occasional E of Hall Lake in prairie fen, *Miller* 197.
- Alopecurus aequalis* Sobol., Short-awned foxtail, along margin of north swamp, *Gilbert* 49265. No recent observation.
- Andropogon gerardii* Vitman, Big bluestem, along Consumers Energy power line right-of-way remnant oak openings understory, *Gilbert* 49417. Recent observation.
- Arrhenatherum elatius* (L.) J. Presl & C. Presl, Tall oatgrass, common along Consumers Energy power line right-of-way trail remnant oak openings understory and sandy area E of Hall Lake, *Miller* 45, 59.
- Brachyelytrum erectum* (Roth) P. Beauv., Long-awned wood grass, forest floor in upland hardwood, *Gilbert* 50127. No recent observation.
- Bromus ciliatus* L., Fringed brome, occasional on E side of Hall Lake on wet margin of prairie fen, *Miller* 163.
- B. inermis* Leyss., Smooth brome, common along Consumers Energy power line right-of-way remnant oak openings understory and common near Arlington parking lot, *Miller* 54, 104.
- B. japonicus* Murray, Japanese brome, along Consumers Energy power line right-of-way remnant oak openings understory, *Gilbert* 54006, *Miller* 73.
- **B. pubescens* Willd., Canada brome, occasional in oak-hickory forest, *Gilbert* 49192, *Miller* 124, 187.
- B. tectorum* L., Downy chess, common along Consumers Energy power line right-of-way remnant oak openings understory, *Gilbert* 49150, 54006, *Miller* 63.
- Calamagrostis canadensis* (Michx.) P. Beauv., Blue-joint, Consumers Energy power line right-of-way, *Gilbert* 49272, 49273. Recent observation.
- Cenchrus longispinus* (Hack.) Fernald, Sandbur, along roadside near Dexter esker, *Gilbert* 50156. No recent observation.
- Dactylis glomerata* L., Orchard grass, common along Consumers Energy power line right-of-way remnant oak openings understory, *Miller* 56, 74, 117.
- Dichanthelium columbianum* (Scribn.) Freckmann, Panic grass, along entrance from Brownlee Rd., *Gilbert* 49211. No recent observation.
- D. implicatum* (Scribn.) Kerguelen, Panic grass, locally common at wet margin of pond at end of power line right-of-way, *Miller* 222.
- D. latifolium* (L.) Harvill, Broad-leaved panic grass, locally common in oak-hickory forest on N side of property, *Gilbert* 49222b, *Miller* 125.
- D. meridionale* (Ashe) Freckmann, Mat panic grass, locally common along Consumers Energy power line right-of-way remnant oak openings understory, *Miller* 68.
- D. oligoanthos* (Schult.) Gould, Panic grass, locally common along Consumers Energy power line right-of-way remnant oak openings understory, *Gilbert* 49161, *Miller* 53.
- Digitaria cognata* (Schult.) Pilg., Fall witch grass, locally common on Consumers Energy power line right-of-way in remnant oak openings understory, *Miller* 261.
- D. sanguinalis* (L.) Scop., Hairy crab grass, parking area near Brigham esker, *Gilbert* 49492. No recent observation.

Echinochloa crusgalli (L.) P. Beauv., Barnyard grass, margin of Brigham esker on extreme south end, *Gilbert 49469*. No recent observation.

Elymus hystrix L., Bottlebrush grass, uncommon in oak-hickory forest on NW side of property, *Gilbert 49285*. Recent observation.

**E. repens* (L.) Gould, Quack grass, occasional along Consumers Energy power line right-of-way trail remnant oak openings understory, *Miller 132*.

Eragrostis spectabilis (Pursh) Steud., Tumble grass, locally common on Consumers Energy power line right-of-way in remnant oak openings understory, *Gilbert 49451, Miller 260*.

Festuca subverticillata (Pers.) E. B. Alexeev, nodding fescue, occasional in oak-hickory forest, *Miller 33, 78*.

Glyceria canadensis (Michx.) Trin., Rattlesnake grass, locally common in dried up swamp on N side of property, *Gilbert 49267, Miller 181*.

G. striata (Lam.) Hitchc., Fowl manna grass, occasional on E side of Hall Lake on wet margin of prairie fen, *Gilbert 54001, Miller 160*.

Leersia oryzoides (L.) Sw., Cut grass, locally common in dried up swamp on N side of property, *Miller 178*.

**Lolium arundinaceum* (Schreb.) Darbysh., Tall fescue, occasional E of Jameson parking lot in disturbed oak-hickory forest, *Miller 81*.

L. pratense (Huds.) Darbysh., Meadow fescue, on Consumers Energy power line right-of-way remnant oak openings understory, *Miller 84*.

Muhlenbergia glomerata (Willd.) Trin., Marsh wild-timothy, occasional on E side of Hall Lake on wet margin of prairie fen, *Gilbert 54061, Miller 167*.

**Panicum flexile* (Gatt.) Scribn., Panic grass, prairie fen near Hall Lake, *Miller 269*.

P. virgatum L., Switch grass, common on Consumers Energy power line right-of-way remnant oak openings understory, *Miller 248*.

Phalaris arundinacea L., Reed canary grass, north swamp, locally common near pond at N end of Consumers Energy right-of-way along remnant oak openings understory and in emergent marsh on E side of Brigham Lake, *Gilbert 54010, Miller 65, 86, 129*.

Phleum pratense L., Timothy, occasional on Consumers Energy power line right-of-way remnant oak openings understory, *Gilbert 49213, 5061, 5213*. Recent observation.

Phragmites australis L. subsp. *australis*, Reed, uncommon in bog area S of Brigham Lake near bridge, *Skean 5064*.

Poa compressa L., Canada bluegrass, along road of Brownlee Park entrance, *Gilbert 49212, 54011*. No recent observation.

P. nemoralis L., Bluegrass, Oak-hickory forest, *Miller 79*.

P. pratensis L., Kentucky bluegrass, common on Consumers Energy power line right-of-way and sandy area E of Hall Lake, *Gilbert 49151, 54007, Miller 44, 55, 57*.

Schizachyrium scoparium (Michx.) Nash, Little bluestem, locally common along Consumers Energy power line right-of-way remnant oak openings understory, *Miller 215, 258*.

Setaria pumila (Poir.) Roem. & Schult., Yellow foxtail, locally common on Consumers Energy power line right-of-way remnant oak openings understory, *Gilbert 49484, Miller 250*.

**S. verticillata* (L.) P. Beauv., Bristly foxtail, occasional on Consumers Energy power line right-of-way remnant oak openings understory, *Miller 246*.

Sorghastrum nutans (L.) Nash, Indian grass, locally common at edge of disturbed oak-hickory forest near Arlington entrance, *Miller 263*.

Spartina pectinata Link, Cordgrass, north swamp, *Gilbert 50145*. No recent observation.

Tridens flavus (L.) Hitchc., Purpletop, common on Consumers Energy power line right-of-way remnant oak openings understory, *Miller 247*.

POLEMONIACEAE

Phlox pilosa L., Prairie phlox, locally common on Consumers Energy power line right-of-way in remnant oak openings understory, *Gilbert 49136, 49137*. Recent observation.

POLYGALACEAE

Polygala senega L., Seneca snakeroot, along bridle path in bridle trail woods near corner of preserve, *Gilbert 5016*. No recent observation.

POLYGONACEAE

***Fallopia convolvulus* (L.) Á Löve**, False buckwheat, near Brownlee Park entrance, *Gilbert* 5074, 5097. No recent observation.

****F. japonica* (Houtt.) Ronse Decr.**, Japanese knotweed, occasional near Arlington entrance in disturbed oak-hickory forest and at end of Consumers Energy power line right-of-way remnant oak openings understory, *Miller* 10, 262.

F. scandens (L.) Holub, False buckwheat, uncommon on Consumers Energy power line right-of-way in remnant oak openings understory, *Miller* 213.

Persicaria amphibia (L.) A. Gray var. *emersa* (Michx.) J. C. Hickman, Water smartweed, boggy area near Hall Lake, *Gilbert* 49478, 50142. Recent observation.

P. amphibia (L.) A. Gray var. *stipulacea* (N. Coleman) H. Hara, Water smartweed, wet marsh; some growing in water in north swamp, *Gilbert* 49269, 50143. No recent observation.

P. pennsylvanica (L.) M. Gómez, Pinkweed, north swamp, *Gilbert* 49356, 49479. No recent observation.

P. punctata (Elliott) Small, Smartweed, wet margin of prairie fen on W side of Hall Lake, *Gilbert* 49357, 49473, 49456, 49480. Recent observation.

P. sagittata (L.) H. Gross, Arrow-leaved tear-thumb, open areas along stream between Brigham and Hall Lakes, *Gilbert* 49467, 49488, *Skean* 5026.

P. virginiana (L.) Gaertn., Jumpseed, locally common in hardwood swamp W of east esker, *Gilbert* 49432, *Miller* 207.

***Polygonum aviculare* L.**, Knotweed, sandy roadway leading in from Brownlee Park entrance, *Gilbert* 5091. No recent observation.

***Rumex acetosella* L.**, Red sorrel, locally common on Consumers Energy power line right-of-way remnant oak openings understory, *Gilbert* 49130, *Miller* 60.

***R. crispus* L.**, Sour dock, locally common near Jameson entrance in disturbed oak openings understory, *Gilbert* 49224. Recent observation.

***R. obtusifolius* L.**, Bitter dock, open upland hardwood SE extreme border of preserve and tamarack on bank of inlet stream to Hall Lake, *Gilbert* 49242, 5053. No recent observation.

POTAMOGETONACEAE

Potamogeton berchtoldii Fieber, Pondweed, Brigham Lake, *Gilbert* 5296. No recent observation.

P. foliosus Raf., Leafy pondweed, Hall Lake submerged aquatic, *Gilbert* 5296, *Miller* 240.

P. illinoensis Morong, Illinois pondweed, Brigham and Hall Lake submerged aquatic, *Gilbert* 5294, *Miller* 237, 244.

P. natans L., Pondweed, Brigham Lake, *Gilbert* 5293. No recent observation.

Stuckenia pectinata (L.) Boerner, Sago pondweed, Hall Lake, *Gilbert* 5233. No recent observation.

PRIMULACEAE

Lysimachia lanceolata Walter, Lance-leaved loosestrife, under second growth hardwoods highland edge of preserve E of Brigham Lake, *Gilbert* 5052. No recent observation.

L. quadriflora Sims, Whorled loosestrife, common on wet margin of prairie fen on E side of Hall Lake, *Gilbert* 49287, 49329. Recent observation.

L. quadrifolia L., Whorled loosestrife, occasional on NW side of property in oak-hickory forest, *Gilbert* 49493, *Miller* 136.

L. terrestris (L.) Britton, Sterns, & Poggenb., Swamp-candles, swamp just below entrance to Brownlee Park, *Gilbert* 49304. No recent observation.

L. thyrsiflora L., Tufted loosestrife, lowland N of middle central esker, *Gilbert* 49122. No recent observation.

Trientalis borealis Raf., Star-flower, moist low woodlands between Brigham and Hall Lakes, *Gilbert* 4979. Recent observation.

RANUNCULACEAE

Actaea rubra (Aiton) Willd., Red baneberry, occasional in oak-hickory forest, *Gilbert* 4981. Recent observation.

Anemone cylindrica A. Gray, Thimbleweed, bridle trail that leads to Brownlee Park entrance, *Gilbert* 49249, 49316. No recent observation.

- A. quinquefolia* L., Wood anemone, locally common in oak-hickory forest, *Gilbert* 4836, 4945. Recent observation.
- A. virginiana* L., Thimbleweed, occasional in oak-hickory forest N of Brigham Lake, *Gilbert* 49292, 49300, 49348, *Miller* 182.
- Aquilegia canadensis* L., Wild columbine, occasional in hardwood swamp, *Gilbert* 4978. Recent observation.
- Caltha palustris* L., Marsh-marigold, occasional in hardwood swamp, *Gilbert* 4635, 4956. Recent observation.
- Clematis virginiana* L., Virgin's bower, low wet woodlands S of Brigham Lake and in west swamp, *Gilbert* 5088, 50122. No recent observation.
- Coptis trifolia* (L.) Salisb., Goldthread, lowland forest floor and locally common in swamps, *Gilbert* 4637, 4833. Recent observation.
- Hepatica americana* (DC.) Ker Gawl., Round-lobed hepatica, common on eskers, *Gilbert* 4640. Recent observation.
- Ranunculus abortivus* L., Small-flowered buttercup, low woodlands and on moist hillsides, *Gilbert* 4941. Recent observation.
- R. acris* L.**, Common buttercup, just inside NE entrance from Wattles Rd., *Gilbert* 49221. No recent observation.
- R. recurvatus* Poir., Hooked crowfoot, common in low woodlands, *Gilbert* 4997. Recent observation.
- R. sceleratus* L., Cursed crowfoot, occasional in dried up swamp on N side of property, *Miller* 176.
- Thalictrum dasycarpum* Fisch. & Ave-Lall., Purple meadow-rue, low, rich moist woods & sphagnum bogs, *Gilbert* 49191. Recent observation.
- T. dioicum* L., Early meadow-rue, locally common in hardwood swamp and oak-hickory forest, *Gilbert* 5026. Recent observation.
- T. thalictroides* (L.) Eames & Boivin, Rue-anemone, occasional along esker in oak-hickory forest, *Gilbert* 4951, *Miller* 22.

RHAMNACEAE

- Ceanothus americanus* L., New Jersey tea, locally common on Consumers Energy power line right-of-way in remnant oak openings understory, *Gilbert* 49225, 49227. Recent observation.
- Frangula alnus* Mill.**, Glossy buckthorn, common in areas surrounding Brigham and Hall Lake, *Gilbert* 5073, *Miller* 13, 18.
- **Rhamnus alnifolia* L'Her., Alder-leaved buckthorn, swampy area around Hall and Brigham Lake, *Gilbert* 4965, 49449. No recent observation.
- ****R. cathartica* L.**, Common buckthorn, common near Arlington entrance of oak-hickory disturbed forest and on W side of Hall Lake on wet margin of prairie fen, *Miller* 9, 144.

ROSACEAE

- Agrimonia gryposepala* Wallr., Tall agrimony, moist, sandy soil along lane leading down to Brigham Lake from esker, and under tamarack near inlet streams E border of Hall Lake, *Gilbert* 49241, 49298. Recent observation.
- Amelanchier arborea* (F. Michx.) Fernald, Juneberry, bordering road that cuts off Brigham esker to north swamp, *Gilbert* 4959, 5036. Recent observation.
- A. interior* Nielsen, Serviceberry, bordering road that cuts off from Brigham Lake to N. swamp, *Gilbert* 49274, 5027. No recent observation.
- Aronia prunifolia* (Marshall) Rehder, Chokeberry, common in and at margins of bogs and sphagnum mat at N end of Brigham Lake, *Gilbert* 5064, 4972. No recent observation.
- Comarum palustre* L., Marsh cinquefoil, common in swampy area W of Wattles esker, *Gilbert* 49149. No recent observation.
- Crataegus margaretta* Ashe, Hawthorn, upland oak-hickory forest, *Gilbert* 4976. Recent observation.
- Dasiphora fruticosa* (L.) Rydb., Shrubby cinquefoil, common in prairie fen, *Gilbert* 49128. Recent observation.
- Drymocallis arguta* (Pursh) Rydb., Tall cinquefoil, sandy grassy hillside W of temporary swamp, *Gilbert* 49248. No recent observation.

- Fragaria virginiana* Mill., Wild strawberry, occasional on Consumers Energy power line right-of-way, *Gilbert 4940*. Recent observation.
- Geum aleppicum* Jacq., Yellow avens, moist meadow bordering grass and sedge and sedge swamp near middle esker, *Gilbert 49257, 49396*. No recent observation.
- G. canadense* Jacq., White avens, common in oak-hickory forest and hardwood swamp, *Gilbert 49256, 50102*. Recent observation.
- G. virginianum* L., Pale avens, uncommon in hardwood swamp W of east esker, *Gilbert 50101, Miller 204*.
- Potentilla argentea* L.**, Silvery cinquefoil, sandy dry ridges, *Gilbert 49129*. No recent observation.
- P. norvegica* L., Rough cinquefoil, locally common near Arlington entrance in oak-hickory forest, *Gilbert 49370, 54009, Miller 154*.
- P. recta* L.**, Rough-fruited cinquefoil, locally common near Jameson parking lot in disturbed oak openings understory, *Gilbert 49164, 49219*. Recent observation.
- P. simplex* Michx., Common cinquefoil, locally common near Jameson parking lot in disturbed oak openings understory, *Gilbert 49101, Miller 49*.
- Prunus americana* Marshall, American wild plum, second growth hardwood W side of hill from west swamp, *Gilbert 50152*. No recent observation.
- P. avium* (L.) L.**, Sweet cherry, second growth upland hardwood near E margin in SE corner of preserve, *Gilbert 50125*. No recent observation.
- **P. pensylvanica* L.f., Pin cherry, uncommon on Consumers Energy power line right-of-way remnant oak openings understory, *Miller 277*.
- P. pumila* L. var. *susquehanae* (Willd.) Jaeger, Sand cherry, common in sandy soil at S end of Hall esker in open area, *Gilbert 4967*. No recent observation.
- P. serotina* Ehrh., Wild black cherry, common in oak-hickory forest throughout preserve, *Gilbert 49391, 49454, 49390*. Recent observation.
- P. virginiana* L., Choke cherry, common on eskers, *Gilbert 49293, 49325, 4977, 50100, 4970*. No recent observation.
- Rosa carolina* L., Pasture rose, uncommon on Consumers Energy power line right-of-way remnant oak openings understory, *Gilbert 49159, 49226, 50129*. Recent observation.
- R. multiflora* Murray**, Multiflora rose, locally common in boggy area near bridge, *Miller 39*.
- R. palustris* Marshall, Swamp rose, common in open areas at edges of wetlands, *Gilbert 49284, 49305, 49459, 49491*. Recent observation.
- R. palustris* Marshall f. *inermis* (Regel) W. H. Lewis, Swamp rose, boggy area near Brigham Lake, *Gilbert 49457*. Recent observation.
- Rubus allegheniensis* Porter, Common blackberry, occasional in oak-hickory forest near hardwood swamps, *Gilbert 49389*. Recent observation.
- R. flagellaris* Willd., Northern dewberry, occasional along Consumers Energy power line right-of-way trail remnant oak openings understory, *Miller 61*.
- R. hispidus* L., Swamp dewberry, locally common in hardwood swamp NE of Hall Lake, *Gilbert 5070, Miller 210*.
- R. occidentalis* L., Black raspberry, common in disturbed oak-hickory forest near Arlington entrance, *Gilbert 49385*. Recent observation.
- R. pubescens* Raf., Dwarf raspberry, rare along E edge of Hall Lake on wet margin of prairie fen, *Gilbert 4949, Miller 111*.
- R. setosus* Bigelow, Bristly blackberry, near Arlington entrance of oak-hickory forest, *Gilbert 5071, Miller 27*.
- R. strigosus* Michx., Wild red raspberry, occasional in oak-hickory forest, *Gilbert 5075*. Recent observation.
- Spiraea alba* Du Roi, Meadowsweet, occasional on Consumers Energy power line right-of-way remnant oak openings understory, *Gilbert 49258, 49321*. Recent observation.
- S. tomentosa* L., Hardhack, swampy bog adjacent to road leading in from Brownlee Park entrance, *Gilbert 49365, 49458*. No recent observation.

RUBIACEAE

- Galium aparine* L., Goosegrass, on wet, swampy, or low, moist forest floor, *Gilbert 49112, 4985*. Recent observation.

- G. asprellum* Michx., Rough bedstraw, abundant in border of W swamp, *Gilbert 5098, 54030*. No recent observation.
- G. boreale* L., Northern bedstraw, swamp area around Hall Lake near outlet and low swampy area at base of esker, *Gilbert 49139, 49176, 5037*. No recent observation.
- G. circaeazans* Michx., White wild licorice, locally common in oak-hickory forest near end of power line right-of-way, *Gilbert 49254, 5055, Miller 225*.
- G. concinnum* Torr. & A. Gray, Shining bedstraw, under second growth hardwood laboratory hill, *Gilbert 50114*. No recent observation.
- G. labradoricum* (Wiegand) Wiegand, Bog bedstraw, in bogs surrounding Hall Lake, *Gilbert 5031*. No recent observation.
- G. tinctorium* L., Stiff bedstraw, common in hardwood swamp surrounding Brigham boardwalk, *Gilbert 5090, Miller 191*.
- G. trifidum* L., Small bedstraw, locally common in boggy area on N side of Brigham Lake, *Gilbert 49401, Miller 232*.
- G. triflorum* Michx., Fragrant bedstraw, locally common in hardwood swamp W of east esker, *Gilbert 54031, Miller 206*.
- Houstonia longifolia* Gaertn., Long-leaved bluets, along road from Brownlee Park leading into NW entrance, *Gilbert 49208, 5017*. No recent observation.
- Mitchella repens* L., Partridge-berry, common in swampy areas, *Gilbert 485*. Recent observation.

SALICACEAE

- Populus deltoides* Marshall, Cottonwood, uncommon along Consumers Energy power line right-of-way in remnant oak openings understory, *Miller 83*.
- P. grandidentata* Michx., Large-tooth aspen, common generally in low areas bordering streams and on border of remnant oak openings understory, *Gilbert 49237*. Recent observation.
- P. tremuloides* Michx., Quaking aspen, uncommon near Jameson entrance in remnant oak openings understory, *Gilbert 49238*. Recent observation.
- Salix bebbiana* Sarg., Bebb's willow, at margin of swamp parallel to road leading in road leading to Brownlee Park and in middle of west swamp, *Gilbert 5076, 5077*. No recent observation.
- S. candida* Willd., Sage willow, mat bordering Brigham Lake on S side, *Gilbert 49448*. No recent observation.
- S. discolor* Muhl., Pussy willow, occasional on E side of Hall Lake on wet margin of prairie fen and on Consumers Energy power line right-of-way remnant oak openings understory and locally common in hardwood swamp surrounding Brigham boardwalk, *Gilbert 5083, 50104, Miller 159, 172, 190*.
- S. eriocephala* Michx., Willow, shrubby border of margin of west swamp, *Gilbert 5082, Miller 157*.
- S. exigua* Nutt., Sandbar willow, near base of hill W of north swamp on W side of hill and border of swamp near outlet to Hall Lake, *Gilbert 50106, 50160*. No recent observation.
- **S. humilis* Marshall, Upland willow, edge of swamp at end of road leading in from Brownlee Park and margin of swamp about 300' N of road leading in from Brownlee Park (west swamp), *Gilbert 5011, 5080*. Recent observation.
- S. lucida* Muhl., Shining willow, common shrub in west swamp, *Gilbert 5062*. No recent observation.
- S. petiolaris* Sm., Slender willow, from middle of shrubby border of west swamp, *Gilbert 5078, 5079*. No recent observation.
- S. serissima* (L.H. Bailey) Fernald, Autumn willow, shrubby border of bogs at Hall Lake and in grass and sedge bog parallel to road leading in from Brownlee Park, *Gilbert 49240*. No recent observation.

SANTALACEAE

- Comandra umbellata* (L.) Nutt., Bastard-toadflax, occasional on sandy ridges, cinder pile at end of road leading in from Brownlee Park, *Gilbert 49135, 5014*. No recent observation.

SAPINDACEAE

Acer negundo L., Box-elder, common on Sutarek loop in disturbed oak-hickory forest, Gilbert 49223. Recent observation.

A. platanoides L., Norway maple, common near Arlington entrance of disturbed oak-hickory forest, Miller 8.

A. rubrum L., Red maple, common in oak-hickory forest, Gilbert 49177. Recent observation.

A. saccharinum L., Silver maple, Occasional on Consumers Energy power line right-of-way remnant oak openings understory, Miller 100.

SARRACENIACEAE

Sarracenia purpurea L., Pitcher-plant, common in prairie fen between Hall and Dexter Lake, Gilbert 4641. Recent observation.

SAURURACEAE

**Saururus cernuus* L., Lizard's tail, occasional on W side of Hall Lake on wet margin of prairie fen, Miller 227.

SAXIFRAGACEAE

Heuchera americana L., Alum root, uncommon in oak-hickory forest on N side of property, Gilbert 49232. Recent observation.

Mitella diphylla L., Bishop's cap, common in rich lowlands, Gilbert 4835. Recent observation.

Micranthes pensylvanica (L.) Haw., Swamp saxifrage, common in wet, swampy areas, Gilbert 4998. Recent observation.

SCROPHULARIACEAE

Scrophularia lanceolata Small, Early figwort, occasional in oak-hickory forest before Brigham boardwalk, Gilbert 49158, Miller 188.

Verbascum blattaria L., Moth mullein, Consumers Energy power line right-of-way, Gilbert 54004. Recent observation.

V. thapsus L., Flannel plant, occasional along Consumers Energy power line right-of-way remnant oak openings understory and near Arlington entrance, Gilbert 49306. Recent observation.

SIMAROUBACEAE

**Ailanthus altissima* (Mill.) Swingle, Tree-of-heaven, locally common on Sutarek loop in disturbed oak-hickory forest, Miller 106.

SMILACACEAE

Smilax hispida Raf., Bristly Greenbrier, uncommon in swamp NE of Hall Lake, Gilbert 49119, 49178, 49399. Recent observation.

S. illinoensis Mangaly, Carrion-flower, Brigham esker and Wattles esker above temporary swamp, Gilbert 49152, 5023. No recent observation.

S. lasioneura Hook., Carrion-flower, occasional in oak-hickory forest on N side of property, Gilbert 49172, Miller 80.

SOLANACEAE

Physalis heterophylla Nees, Clammy ground-cherry, sandy hillsides SW corner of preserve, Gilbert 49335, 50140. No recent observation.

Solanum carolinense L., Horse-nettle, sandy weedy grassy pasture just E of SE arm of preserve and on W border of preserve, Gilbert 49315, 49352. No recent observation.

S. dulcamara L., European bittersweet, common near Arlington entrance of disturbed oak-hickory forest and edge of Brigham Lake, Gilbert 49148, Miller 11.

S. dulcamara L. f. *albiflorum* Farw., European bittersweet, uncommon in boggy area around Brigham Lake, Gilbert 5038. Recent observation.

TRILLIACEAE – SEE MELANTHIACEAE

TYPHACEAE

**Typha angustifolia* L., Narrow-leaved cat-tail, locally common on W side of Hall Lake on wet margin of prairie fen and E side of Brigham Lake in boggy area, Miller 145. Recent

observations of apparent *Typha* \times *glauc*a Godr., the hybrid between *T. angustifolia* and *T. latifolia*.

T. latifolia L., Common cat-tail, locally common in boggy area N of Hall Lake and around Brigham Lake, *Gilbert* 49264, 54056. Recent observation.

ULMACEAE

Ulmus americana L., American elm, Oak-hickory forest, *Gilbert* 49182. Recent observation.

U. pumila L., Siberian elm, common along trail near Arlington entrance in oak-hickory forest. *Miller* 19, 20.

U. rubra Muhl., Slippery elm, disturbed oak-hickory forest, *Gilbert* 5094. Recent observation.

UTRICACEAE

Boehmeria cylindrica (L.) Sw., False nettle, occasional in hardwood swamp, *Gilbert* 49387, 49297, 54023, *Skean* 5027.

Laportea canadensis (L.) Wedd., Wood nettle, on banks of inlet stream to Brigham Lake, *Gilbert* 5099. No recent observation.

Pilea pumila (L.) A. Gray, Clearweed, in small east swamp, *Gilbert* 49440. Recent observation.

Urtica dioica L. subsp. *gracilis* (Aiton) Selander, Stinging nettle, border of small E swamp, *Gilbert* 49429. Recent observation.

VALERIANACEAE – SEE CAPRIFOLIACEAE

VERBENACEAE

Verbena bracteata Lag. & Rodr., Creeping vervain, along roadsides on Dexter esker, *Gilbert* 50157. No recent observation.

V. hastata L., Blue vervain, in wet margin near Dexter Lake, *Gilbert* 49363. Recent observation.

V. stricta Vent., Hoary vervain, along roadside on extreme SW portion of preserve, *Gilbert* 50167, 5255. No recent observation.

VIOLACEAE

Viola blanda Willd., Sweet white violet, in hardwood swamp and in wet areas near lakes, *Gilbert* 4634, 4837, 4953. Recent observation.

V. labradorica Schrank, Dog violet, woodlands around Brigham Lake and in low moist woods, *Gilbert* 4632, 4636, 4838, 4948, 4954. No recent observation.

V. nephrophylla Greene, Northern bog violet, wet margins of Hall and Brigham Lakes, *Gilbert* 4986. No recent observation.

V. pedata L., Birdfoot violet, sandy soil adjacent to road leading in from Brownlee Park entrance, *Gilbert* 504. No recent observation.

V. pubescens Aiton, Yellow violet, oak-hickory forest on S side of preserve, *Gilbert* 502. Recent observation.

V. sororia Willd., Common blue violet, common in disturbed oak-hickory forest near Arlington entrance, *Gilbert* 4839, 4947, 4955, *Skean* 5010.

VITACEAE

Parthenocissus quinquefolia (L.) Planch., Virginia creeper, common in oak-hickory forest throughout preserve, *Gilbert* 49259, 4944. Recent observation.

Vitis aestivalis Michx., Summer grape, uncommon in disturbed oak-hickory forest near remnant prairie, *Gilbert* 50111, 49222. Recent observation.

V. riparia Michx., River-bank grape, common in low woods, *Gilbert* 49118. Recent observation.

***THISMIA AMERICANA*: A CHICAGO ENDEMIC OR AN ELABORATE HOAX?**

Gerould Wilhelm and Laura Rericha

Conservation Research Institute
W59 N412 Hilgen Avenue
Cedarburg, Wisconsin 53012
consresearchinst.wilhelm@gmail.com

ABSTRACT

Named in 1912, *Thismia americana* Pfeiff. was reportedly collected in a wet prairie in Chicago, Illinois, by Norma Pfeiffer, a student at the University of Chicago. For decades, few botanists questioned the authenticity of the find. With advances in biogeography over the last few decades and with rare but significant experience with fraudulent science, some scientists have raised questions about the veracity of Pfeiffer's work. While some have speculated on biogeographic mechanisms that account for a species to have spread from the Asian-Pacific region to a north-temperate one, such as the southwestern Great Lakes, some have toyed with the idea that Pfeiffer's work represents an outright hoax. This article describes an example of botanical fraud, specifically the Rum affair. Pfeiffer's work is recounted, compared with those in science who have masterminded hoaxes, and analyzed with regard to the question whether her work was fraudulent.

KEYWORDS: Biogeography, fraud, hoax, Pfeiffer, *Thismia*

INTRODUCTION

According to her own account, Norma Pfeiffer, a 23-year-old student at the University of Chicago, set out to gather liverworts in a prairie on the south side of Chicago, specifically at 119th Street and Torrence Avenue (Pfeiffer 1914a). During this foray, she encountered a tiny, nearly subterranean, flowering plant, the identity of which was a mystery to her and her advisors. Upon concluding that it was a species of the burmanniaceous genus *Thismia*, the congeners of which are both cryptic and in widely dispersed populations (Merckx & Smets 2014), she gave up a teaching job she had secured out west and remained at the University of Chicago, where she pursued doctoral research on the anatomy, morphology, and taxonomy of the Chicago *Thismia* population. Two years later, she published her findings in the Botanical Gazette (Pfeiffer 1914a), having concluded that, while it was indeed a species of *Thismia*, it was undescribed. She gave it the name *Thismia americana*.

At the time, no one questioned either the identity of the plant or the circumstances of its discovery. Thirteen years later, in his flora of the Chicago region, Herman S. Pepon (1927) included the plant with the annotation: "Sedgy swamp associated with *Selaginella apus*, near Lake Calumet. (Miss Pfeiffer, Dr. Cowles)." He added a quotation from Henry C. Cowles: "A remarkable discovery, no related plants within hundreds of miles; the Genus never before found in North America."

Fernald (1950) described the genus and species, noting its singular occurrence and its relationship to the Tasmanian species, *Thismia rodwayi* F. Muell. Gleason & Cronquist (1963) sustained previous assertions, noting that the plant had not been seen since 1913, they being evidently unaware she had collected specimens in 1914 as well. No floras or treatises that have published on the matter of *Thismia americana* have intimated fraud or cast any aspersions on Norma Pfeiffer or her advisors. Since Pfeiffer's death in 1989, the authors have been asked by several thoughtful botanists, often during visits to herbaria, if we believed Pfeiffer's "story."

Although no one has found forensic evidence that would challenge her work, some scientists have suggested that the north-temperate Chicago endemic *Thismia americana* Pfeiff., a plant in the largely south-temperate to tropical family Burmanniaceae, is a legend based upon a hoax. If one begins with the premise that the discovery of *Thismia americana* is a hoax, then there must be some evidence with which to start—other than that the story seems improbable because of rather serious disjunction issues. There is no evidence, but the rumors persist. For the rumors to have merit, one would also have to conclude that John M. Coulter, Pfeiffer's principal committee member, colluded in the hoax along with her other committee members, Drs. Charles J. Chamberlain and William J. G. Land, of the University of Chicago. One also would need to discover a motive for a hoax. Compounding the improbability of a largely tropical genus inhabiting northeastern Illinois is the fact that Chicago was glaciated during the most recent ice age, along with the circumstance of its already antipodal disjunction from the region inhabited by its sister species.

DISCUSSION

Pfeiffer completed her bachelor's degree at the University of Chicago in 1912 and went on to graduate school there. After having secured a position teaching at a college in North Dakota, she went with a colleague to a favorite place for students at the University of Chicago to study local flora. They were to collect liverworts to have on hand for her prospective teaching position (Masters 1995), since commercially available study specimens were not easily obtainable in those days. It was on that occasion that she discovered *Thismia americana*. Her companion, gathering in the same area, had not noticed *Thismia* until Norma pointed it out. Neither she nor her colleague had any clue as to what it was, and her advisors could not identify it, so she took a deep dive into its morphology. This led to her dissertation research, which she published in the Botanical Gazette (Pfeiffer 1914a). Her description of *Thismia americana* is about as complete as one can imagine, with detailed descriptions of both anatomy and morphology. Having discovered the plant in 1912, she visited the population each week for the rest of the summer and for at least two additional years gathering specimens in all stages of development. She expressed chagrin, however, that she was unable to observe seed germination.

Pfeiffer compared her specimens with the descriptions of all other species of



FIGURE 1. Reproduction of Plate VII in Pfeiffer (1914a) with captions provided by Pfeiffer. 1. Side view of plant of *Thysmia americana*. 2. View of flower from above; petals cut apart at apex and folded back. View from above of group of flowers undisturbed in natural situation; the oldest flower appears at the right. 4. View from above of plants from which the soil has been removed; the white root portions are evident with their buds. In the public domain.

Thismia known at the time and concluded that its closest relatives occurred in the region of southeastern Asia rather than Africa and South America, which would have been perhaps more logical phytogeographically. Plate VII, in Pfeiffer (1914a) (reproduced here as Figure 1), shows photographs of the undisturbed perianths, *in situ*, buried to the lobes in a black sandy Mollisol, a soil that is characteristic of the moist prairie habitat in which the plant once occurred. She felt rather decidedly that no other known species matched the Chicago plants, so she described them as a new species and gave them the name *Thismia americana*. Her dissertation was careful to describe the morphology and anatomy in detail, but there was little discussion of its remarkable disjunction other than to note that it was indeed remarkable.

If she and her mentors had received specimens from elsewhere as part of a botanical caper, she would have had to receive specimens in an array of developmental conditions in several seasonally staggered shipments, all of which survived the voyage from the western Pacific Ocean to Chicago. Even more unlikely, the transshipped specimens would have to have been themselves a new species, because *Thismia americana* remains morphologically and genetically distinct from all other known species (Merckx & Smets 2014). There was a notable botanist, Elmer Drew Merrill, who was collecting actively in the Asia-Pacific region at the time, but it is likely that any correspondence with the University of Chicago would have been through J. M. Coulter or one of his colleagues—rather than through a callow, unknown, brand new graduate student. Merrill did send specimens of algae, lichens, bryophytes, and vascular plants to the Field Museum during this period, but the few *Thismia* specimens at the Field Museum are all from the New World. In addition, the preserved specimens may contain pollen that might link the collection to a region, which we do not think has been done but which would be an interesting exercise (A. A. Reznicek pers. comm.).

We presume that Pfeiffer spent the remainder of the growing season of 1912 trying to figure out the mystery plant's identity. The holotype, which was not collected until 1913, consists of three plants in a packet on a herbarium sheet and a vial with other specimens preserved in formalin–acetic acid–alcohol, which are housed at the Field Museum of Natural History in Chicago. She made another collection in 1914. The specimens are not found in the regular herbarium collection at the Field Museum but are locked in a cabinet to which access is available through the collections manager.

Norma graduated in 1914, the youngest Ph.D. ever from the University of Chicago at that time—and a woman at that—but continued her studies sufficiently to produce another treatise on *Thismia americana*, also published in the *Botanical Gazette*, entitled “The Sporangia of *Thismia americana*” (Pfeiffer 1918). That would have been a time-consuming amount of brilliant energy to put into a hoax considering everyone who must have been involved. Co-conspirators would have included the editors of the well-reviewed *Botanical Gazette* and the southeast-Asian botanist who, rather than do an expository study of the material himself, preferred to supply a student, with whom he had made a more than casual connection and who did not know the genus *Thismia*. With regard to a motive for such hoax, other than the one line in her dissertation (Pfeiffer 1914a) and

a general discussion about “undiscovered plants” (Pfeiffer 1914b), she spent no energy on the biogeographical aspects of *Thismia americana*.

Unfortunately, the area at 119th Street and Torrence Avenue, where Pfeiffer gathered her material, has several feet of fill over it and is in an area that is largely industrial. Indeed, the prairie habitat in which *Thismia americana* once occurred has been essentially destroyed, especially prairie within and on the margins of a major metropolitan area, the city of Chicago. Nevertheless, several noted attempts have been made to discover additional populations.

The first attempt was in 1948, when Floyd Swink (College of Pharmacy, University of Illinois, Chicago) obtained from Pfeiffer a map through the mail detailing the location of the original study population. At that time, Pfeiffer was employed at the Boyce Thompson Institute for Plant Research in Yonkers, New York, now part of Cornell University. Swink, along with Julian Steyermark and José Cuatrecasas, both of the Chicago Natural History Museum, and John Thieret, later of the University of Chicago, failed to locate the plant. In 1985, four years before her passing—at the age of 96—Pfeiffer wrote in a letter to Robert H. Mohlenbrock (Southern Illinois University, Carbondale), that she “looked for the plant beyond the first location, and once found a very few, about a third of a mile away, in the midst of *Typha* . . . between beach ridges” (Mohlenbrock 1985).

In a telephone conversation with bryologist Bill N. McKnight (Illinois Natural History Survey) that same year, she elaborated on some of the cryptogamic associates of *Thismia americana*—which made sense for an interdunal lake plain habitat in Cook County, Illinois, narrated 70 years after the fact (McKnight, pers. comm.; see also the treatment of *Thismia americana* in Wilhelm & Rericha 2017). McKnight asked her if she had collected all the specimens she saw, and she said no, since her interest was not in sending out sets for exchange but in discerning the identity, morphology, and life history of the plants. Having spent the remainder of her career in the study of lily hybrids, she confessed to McKnight that she regretted not having done more field work.

Several “*Thismia* hunts” have occurred since the one by Swink et al. in the Calumet region south of Chicago, but to no avail (Bowles et al. 1994; Rodkin 1994; Chew 2004). It is worth mentioning that in 2017, *Thismia neptunis* Becc. was rediscovered in western Sarawak, Malaysia, not having been seen since the type collection was made in 1866 by an Italian botanist who, it is said, just “stumbled upon it” more or less the way Norma Pfeiffer did with respect to *Thismia americana* in 1912 (Sochor et al. 2018). Like *Thismia americana*, *T. neptunis* is also buried to near the perianth lobes and cryptic in hue, so it is difficult to spot. The new discoverers noted that “its inconspicuous appearance may potentially contribute to our limited knowledge on its distribution as it may be easily overlooked in the field . . .” The same easily can be said for *Thismia americana*.

In fact, Pfeiffer (1914b) described the cryptic, immersed nature of *Thismia* habit. In the early 1990’s, during one “*Thismia* hunt,” the organizers cast 100 small white beads into the vegetation of each of three remnant prairie sites known to have black sandy Mollisols. All were curious to see how many beads would be retrieved by the hordes of searchers combing the area on hands and knees. None were found, even though the beads lay upon the soil.

Had *Thismia americana* been simply a species from Tasmania, then one would imagine that Merckx and Smets (2014), who reviewed the history of the discovery of *T. americana* and examined its relationships within the genus, would have given us more insight into the matter. Although their study, based upon nuclear 18S rDNA and mitochondrial *atp1* and *nad1* b-c data, was inconclusive with regard to phylogeny, they have no hesitation in considering *T. americana* as a distinct taxonomic entity. They agree with Pfeiffer that *T. americana* has its closest relatives within the subgenus *Thismia*. Jonker (1938), who monographed the Burmanniaceae, had suggested that *T. americana* might be conspecific with *T. rodwayi*, but Merckx and Smets (2014), while they posit that both species belong in the same clade, emphasize that *T. americana* and *T. rodwayi* are specifically distinct morphologically and, in particular, that “*T. americana* shows considerable morphological differences with all of the currently known *Thismia* species.” They also point out that the fungal taxon found in the roots of *T. rodwayi* has thus far been detected in Argentina, Finland, and on a prairie in Kansas, which shows a potential for long-distance dispersal of mycoheterotrophic plants. As an alternative, they suggest the Beringia land bridge theory as the most likely explanation for the presence of *Thismia* in North America. It is a matter of some interest, from a timing standpoint at least, that the prairie at 119th and Torrence was probably under Lake Algoma, the last glacial lake stage of Lake Michigan, about 3000 years ago (Willman 1971).

This amphi-Pacific origin was discussed at length by Merckx *et al.* (2017). They write:

“... the deepest diversification events within the *Thismia* clade are estimated to precede these glaciations, while the more recent evolutionary splits [including *T. americana*] may have been influenced by global cooling events. The dispersal and subsequent spread of *Thismia* into Tasmania and New Zealand occurred in the Pleistocene or Holocene. During the Pleistocene, Tasmania was repeatedly glaciated and linked to mainland Australia . . . [O]ur analysis of the most comprehensive and detailed plant and fungal dataset for any mycoheterotrophic system so far, shows that *Thismia*, despite highly specific and phylogenetically conserved AM [arbuscular mycorrhizal] interactions which persist over evolutionary time, was able to diversify and radiate recently due to the wide geographical distribution of the host fungi . . . [A]lthough the mycorrhizal interactions of these mycoheterotrophs are strictly bound to a fungal lineage, host switches remain possible. This process may lead to new ecological opportunities for the plants, and demonstrate that taxa that are dependent on highly specific biotic interactions have ample opportunities to radiate and diversify over the geographical range of their hosts.”

In 1912, Norma Pfeiffer was a very young woman who found herself in an intimidating arena of some of botany's more renowned luminaries, all of whom were men. It would have been quite bold of her, almost unbelievable, to have somehow plotted to secure *Thismia* specimens from the far and distant lands of Tasmania or New Zealand and conceived a deceit that would require a lifetime of intense secrecy and dissembling—even from her older sister, Wanda May, who would marry in 1916 the phytogeographer Dr. Arthur G. Vestal, student of H. C. Cowles. Generally, neither then nor now were graduate students in desperate need of topics for their thesis studies. Certainly, Pfeiffer had no novel theories to promulgate or defend—she had wanted a teaching job. Professors are usually

happy to engage their students in subjects about which they themselves already have scholarly interests. The University of Chicago, esteemed institution that it was, had no faculty of which we are aware that could provide mentorship in the Burmanniaceae.

Also, the site along the railroad at 119th Street and Torrence Avenue was a favored spot for students of the local flora, so it likely was much visited by students of Dr. Cowles and Dr. Coulter as well as themselves and probably Norma's sister and her husband-to-be. She had pointed out the plants to her colleague during her liverwort foray in 1912, but at that time neither nascent botanist knew what she was looking at. We doubt that Pfeiffer was even aware of the Burmanniaceae, much less *Thismia*, which had no known North American representatives.

Some scientists who believe the legend a hoax have stressed that she never went back to look for it after she left the region or that she never reported having looked for it elsewhere: an obvious reason for suspicion in their minds. We are not daunted by that, since it really was not until the post-World War II era that botanists began to develop a strong interest in biosystematics and species threatened with extinction. Not appreciating the factors that one day would redound to her discovery, she would feel no need to record a chain of custody for her harvests and observations and likely did not feel the need to keep a journal of all who looked for it and did or did not see it. Although we cannot imagine that her committee, by 1914, had demurred on taking the train to see the plants in the field.

Comparisons between Pfeiffer's discovery and the dissembling assertions about plant disjunctions at Rum Island in the Hebrides of Scotland—a history that is recounted by Sabbagh (1999)—are inevitable. A noted and admired professor, John William Heslop Harrison of Newcastle University in England, proposed the theory that vegetation on the islands of the west coast of Scotland had survived through the Pleistocene. His reports of the presence of disjunct species, which he planted on the island to support his thesis, were determined to be fraudulent by English classics scholar and amateur botanist, John J. Raven. While it is hard for many of us to get into the mind of someone who would do such a thing, Heslop Harrison was a full professor with a doctrine to defend and who went to byzantine lengths to support his theory. Sabbagh's account of the fraud draws the character of a man and his mission so completely unlike Norma Pfeiffer's that it scarcely warrants ink to compare them. Sabbagh details the collegiate environment within which Heslop Harrison operated and the investigation into the authenticity of his assertions. Because the deceit was obvious to those who looked into it, Heslop Harrison's rather shoddy fraud was readily exposed.

CONCLUSION

If the *Thismia americana* legend is based upon a hoax, then it is a very elaborate, well thought through one, and one that is also dependent on the fortuitous fact that the putative Asian co-conspirator provided specimens that represented a

new species. The Rum affair was largely the effort of a single doctrinally driven individual without co-conspirators. There were, at the time Norma Pfeiffer discovered *T. americana*, no doctrinal theories concerning evolution or biogeography that the *Thismia* find in Chicago would enhance or disprove, certainly none of her own. Also, in 1912 such wide disjunctions of plants from around the world were not altogether to be unexpected, particularly in a genus such as *Thismia* in which many of the species are rather rare and specialized in their habitats. Moreover, one should ignore the fact that the type locality and much of the surrounding area has been destroyed and that the photographs of the plants in situ in a Mollisol such as that characteristic of remnants nearby would be very difficult to stage. As improbable as the discovery of *Thismia americana* in Chicago might be, we would suggest that a hoax that has survived critical thinking and examination this long is even more improbable—even if one could quantify improbability.

LITERATURE CITED

- Bowles, M., M. Jones, L. Wetstein, R. Hyerczk, and K. Klick. (1994) Results of a systematic search for *Thismia americana* Pfeiffer in Illinois. The Morton Arboretum, Lisle, Illinois.
- Chew, R. (2004) *Thismia americana*, a mystery that still haunts and helps the Calumet Region. Chicago Wilderness Magazine. Summer issue.
- Fernald, M. L. (1950) Gray's manual of botany, 8th edition. American Book Company, New York, N.Y.
- Gleason, H. A., and A. Cronquist. (1963) Manual of vascular plants of Northeastern United States and adjacent Canada. The New York Botanical Garden, New York, N.Y.
- Jonker, F. P. (1938). A monograph of the Burmanniaceae. Mededeelingen van het Botanisch Museum en Herbarium van de Rijks Universiteit te Utrecht 51: 1–279.
- Masters, L. (1995). *Thismia americana* N. E. Pfeiffer, a history. *Erigenia* 14: 8–14.
- Merckx, V. S. F. T., S. I. F. Gomes, M. Wapstra, C. Hunt, G. Steenbeeke, C. B. Mennes, N. Walsh, *et al.* (2017). The biogeographical history of the interaction between mycoheterotrophic *Thismia* (Thismiaceae) plants and mycorrhizal *Rhizophagus* (Glomeraceae) fungi. *Journal of Biogeography*. 44: 1869–1879.
- Merckx, V. S. F. T. and E. F. Smets. (2014). *Thismia americana*, the 101st anniversary of a botanical mystery. *International Journal of Plant Sciences* 175: 165–175.
- Mohlenbrock, R. H. (1985) Recent developments in *Thismia americana*. *Erigenia* 5:31–39.
- Pepoon, H. S. (1927) An annotated flora of the Chicago area. Chicago Academy of Science, Chicago, Illinois.
- Pfeiffer, N. E. (1914a). Morphology of *Thismia americana*. *Botanical Gazette* 57: 122–135.
- Pfeiffer, N. E. (1914b). Undiscovered plants. *Quarterly Journal of the University of North Dakota* 5: 43–48.
- Pfeiffer, N. E. (1918). The sporangia of *Thismia americana*. *Botanical Gazette* 66: 354–363.
- Sabbagh, Karl. (1999). A Rum affair: A true story of botanical fraud. Farrar, Straus and Giroux, New York, N.Y.
- Sochor, M., Z. Egertová, M. Hron s, and M. Dan ák. (2018). Rediscovery of *Thismia neptunis* (Thismiaceae) after 151 years. *Phytotaxa* 340: 71–78.
- Wilhelm, G., and L. Rericha. (2017). The flora of the Chicago region: A floristic and ecological synthesis. Indiana Academy of Science, Indianapolis.
- Willman, H. B. (1971). Summary of the geology of the Chicago area. Circular No. 460. Illinois State Geological Survey, Urbana.

HOW LARGE CAN *TAXUS CANADENSIS* GROW?

Susan Fawcett

Pringle Herbarium, Department of Plant Biology
University of Vermont, 111 Jeffords Hall, 63 Carrigan Dr.
Burlington VT 05105
susan.fawcett@gmail.com

Anton A. Reznicek

University of Michigan Herbarium
3600 Varsity Drive
Ann Arbor, MI 48108

Sherwin Carlquist (1974) proposed that the evolution of insular woodiness is favored in part by a moderated climate. Proximity to the ocean buffers the extremes of temperature and humidity and, together with the absence of large herbivores, fosters the evolution of increased stature in many angiosperm families, frequently in conspicuous contrast to their continental herbaceous relatives (see Baldwin et al. 1998). Perhaps these same conditions, which are characteristic of the climate of South Manitou Island in Lake Michigan, but operating on a much shorter timescale and acting on phenotypes, have promoted the growth of three state champion trees and shrubs, including a national champion (Ehrle 2006), on an island only three miles wide by three miles long.

As Voss and Reznicek noted (2012), *Taxus canadensis* Marshall (Canada yew) is “favored by the moist winds from Lake Michigan and [is] often luxuriant on forested dunes and in coniferous forests near the shore,” as is true in the present case. On August 16th, 2017, we encountered an individual of *Taxus canadensis* of unusually great size that we here register as the state champion, confirmed by Ted Reuschel, the current Michigan Big Tree Coordinator. Using the method described in Ehrle (2006) (which uses the US customary system favored by foresters), we documented its size, and submitted our nomination to the Michigan Big Tree Database (Michigan Botanical Club 2018), the official registry maintained by the Michigan Botanical Club for the past 65 years. The individual exhibits a dominant central trunk (Figure 1) and spreading crown (Figure 2). We measured a height of 15 feet (4.6 m), diameter at breast height of 2.3 inches (5.9 cm), and average crown spread of 5 feet 4 inches (1.6 m). This gives a total point score of 23.5, that is girth in inches at 4½ feet plus height in feet plus ¼ of the average crown spread in feet. The plant is located north of the trail towards the Valley of the Giants (the name given to a stand of immense old-growth *Thuja occidentalis* L.) a few hundred yards northwest of the Lighthouse on South Manitou Island, Leelanau County, 45.008°, –86.096°. The individual was discovered in sandy soil, in a vegetation zone transitioning from dunes to mixed conifer–hardwood forest. The adjacent forest supported extensive development of *Taxus canadensis* in the understory, where many clones formed thick-



FIGURE 1. Habit of champion *Taxus canadensis*, height of 4.6 meters, South Manitou Island, 2017. Photo by Anton A. Reznicek.

ets of ascending branches reaching 2 m. This single slightly leaning stem was in the center of an old clone where the canopy was more open, perhaps from past tree falls.

Taxus canadensis is the sole member of the conifer family Taxaceae that is



FIGURE 2. Bark on central trunk of champion *Taxus canadensis*, South Manitou Island, 2017. Photo by Anton A. Reznicek.

native to Michigan. It may be easily distinguished from the other conifers in the state by its lack of a resinous odor, its needle-like leaves that are strongly decurrent and persistent, and seeds that are surrounded by a scarlet berry-like aril quite unlike the cones in the Pinaceae and Cupressaceae (Voss and Reznicek 2012; Barnes et al. 2016). It is the smallest species of *Taxus* worldwide and the only one that is consistently a modest shrub, with heights of 0.5–2 m given in all standard references (Eckenwalder 2009; Debreczy et al. 2011; Farjon 2017). It also has the smallest leaves and seeds of any species of *Taxus*—the leaves are typically under 2 cm long and less than 2.5 mm wide. It is the only monoecious species of *Taxus*, thereby readily distinguishing it from all of its congeners (Wilson et al 1996; Eckenwalder 2009). The other eight to ten species of *Taxus* are all small to large trees, although exceptional dwarf or decumbent forms are known in *T. baccata* L. and *T. cuspidata* Siebold & Zucc. The maximum heights for species other than *T. canadensis* is given as 6–30 (–45) m (Eckenwalder 2009; Debreczy et al. 2011; Farjon 2017). Only the East Asian *Taxus cuspidata* is known as a sporadic escape in populated areas of southernmost Michigan (Voss and Reznicek 2012).

Taxus canadensis is one of the forest understory species that is most affected by deer herbivory, and, although there are accounts of dense stands of large individuals of *T. canadensis* at least as tall as a person, this situation is unknown

today except in the few rare areas sheltered from deer. There is therefore no reliable information on the ultimate height that *T. canadensis* can achieve. In North America, the rare endemic, *Taxus floridana* Nutt. Ex Chapm., the Florida yew, and *Taxus brevifolia* Nutt., the Pacific yew have had representatives in the National Register of Champion Trees (American Forests 2018) since 1986 and 1959, respectively, but there is no record for *Taxus canadensis*. This is unsurprising, since it is generally considered a “low, straggling, multistemmed shrub . . . to 2m” (Barnes et al. 2016).

The other state champion trees from South Manitou include two additional conifers and a maple: *Juniperis communis* var. *depressa* Pursh (2006), *Acer spicatum* Lam. (1969, superseded a decade later by the national champion, discovered in Houghton County, Michigan), and, most notably, the historic national champion northern white cedar, *Thuja occidentalis*, a 113-foot tall tree that has recently died and is now replaced by the new state champion in the same grove, which is 81 feet in height and was reported in 2006. An additional 12 state champions are reported from Leelanau county across the strait separating South Manitou from the Michigan Mainland, most of them in the vicinity of Sleeping Bear Dunes National Lakeshore (and subject to the moderating influence of Lake Michigan). Among these are four current or former national champions, *Salix petiolaris* Sm. (1975), *Salix purpurea* L. (1971), *Cornus rugosa* Lam. (1965) and *Betula papyrifera* var. *cordifolia* (Regel) Fernald (1972) (Ehrle 2003, 2006).

The great size obtained by *Thuja occidentalis* in the Valley of the Giants was possible only because these trees withstood the extensive deforestation and subsequent fires of the logging era. Their survival has been popularly attributed to the sand incorporated into their bark, owing to their location on the back of the active dune, thereby dulling the sawblades of any lumberman who sought to fell them. Both islands were heavily logged in the late 1800s through early 1900s. South Manitou was an especially popular target during the heyday of Great Lakes shipping because of its natural deep water harbor and abundant timber, serving as a convenient stopover for refueling steamships en route between Chicago and the Straits of Mackinac (Hatt et al. 1948). None of the other champions of South Manitou is considered valuable as a timber species.

In addition to the equable climate, the absence of deer has allowed *Taxus canadensis* to thrive on South Manitou Island, in stark contrast to North Manitou Island, where the species was extirpated by the introduction of white-tailed deer in 1926 (Case and McCulloch 1987). As early as 1947, Leopold et al. (1947) recognized the devastating impact of deer over-abundance on plant communities in the Great Lakes region, and especially on the highly palatable, low-growing *Taxus canadensis*, which, as early as 70 years ago was largely extirpated from vast areas of New York, Pennsylvania, Wisconsin and Michigan. Sadly, this long-lived, slow growing species has become quite rare throughout Michigan as a result of deer browse (Barnes et al. 2016), an effect strikingly confirmed by exclosure studies (e.g., Allison 1990; Holmes et al. 2009), or that can be witnessed by visiting the deer and rabbit exclosure that has been maintained on Bois Blanc island in Lake Huron since 1956 by the Michigan Department of Natural Resources.

With mounting evidence demonstrating the continued disastrous, and in some

cases irreversible, impacts by the over-abundance of deer on plant communities, especially harmful to formerly dominant species of conifers including *Tsuga canadensis* (L.) Carrière, *Thuja occidentalis*, and *Taxus canadensis* (Stromayer and Warren 1997), isn't it time to reconsider our management goals? We agree with the conclusion of Leopold et al. (1947) that "in managing overlarge herds, 'too little and too late' is the worst possible policy."

ACKNOWLEDGMENTS

We would like to thank two anonymous reviewers for helpful comments on the manuscript.

LITERATURE CITED

- Allison, T. D. (1990). The influence of deer browsing on the reproductive biology of Canada yew (*Taxus canadensis* Marsh.). *Oecologia* 83: 523–529.
- American Forests. (2018). Champion trees national register. Available at <https://www.american-forests.org/get-involved/americas-biggest-trees/champion-trees-national-register/> (Accessed Sept. 5, 2018).
- Baldwin, B. G., D. J. Crawford, J. Francisco-Ortega, S. C. Kim, T. Sang, and T. F. Stuessy. (1998). Molecular phylogenetic insights on the origin and evolution of oceanic island plants. Pp. 410–441 in *Molecular systematics of plants II. DNA sequencing*, D. E. Soltis, P. S. Soltis, and J. J. Doyle, editors. Springer, Boston, Massachusetts.
- Barnes, B. V., C. W. Dick, and M. E. Gunn. (2016). *Michigan shrubs and vines: A guide to species of the Great Lakes region*. The University of Michigan Press, Ann Arbor.
- Carlquist, S., (1974). *Island biology*. Columbia University Press: New York, N.Y.
- Case, D. J., and D. R. McCullough. (1987). The white-tailed deer of North Manitou Island. *Hilgardia* 55: 1–57.
- Curtis, J. T., (1959). *The vegetation of Wisconsin: An ordination of plant communities*. University of Wisconsin Press, Madison.
- Debreczy, Z., I. Rácz, and K. Musial. (2011). *Conifers around the world*. 2 volumes. DendroPress Ltd., Budapest, Hungary.
- Eckenwalder, J. E. (2009). *Conifers of the world: The complete reference*. Timber Press, Portland, Oregon.
- Ehrle, E. B. (2003). The champion trees and shrubs of Michigan. *The Michigan Botanist* 42: 3–46.
- Ehrle, E. B. (2006). The big trees and shrubs of Michigan. *The Michigan Botanist* 45: 65–152.
- Farjon, A. (2017). *A handbook of the world's conifers* (2 volumes), revised and updated edition. Brill Academic Publishers, Leiden, The Netherlands.
- Hatt, R. T., J. Van Tyne, L. C. Stuart, C. H. Pope, and A. B. Grobman. (1948). *Island life: A study of the land vertebrates of the islands of eastern Lake Michigan*. Cranbrook Institute of Science, Bulletin No. 27, Bloomfield Hills, Michigan.
- Holmes, S. A., C. R. Webster, D. J. Flaspohler, and R. E. Froese. (2009). Death and *Taxus*: The high cost of palatability for a declining evergreen shrub, *Taxus canadensis*. *Canadian Journal of Forest Research* 39: 1366–1374.
- Leopold, A., L. K. Sows, and D. L. Spencer. (1947). A survey of over-populated deer ranges in the United States. *The Journal of Wildlife Management* 11: 162–177.
- Michigan Botanical Club. (2018). Michigan big tree program. Available at www.michbotclub.org/registry/
- Stromayer, K. A., and R. J. Warren. (1997). Are overabundant deer herds in the eastern United States creating alternate stable states in forest plant communities? *Wildlife Society Bulletin* 25: 227–234.
- Wilson, P., M. Buonopane, and T. D. Allison. (1996). Reproductive biology of the monoecious clonal shrub *Taxus canadensis*. *Bulletin of the Torrey Botanical Club* 123: 7–15.
- Voss, E. G., and A. A. Reznicek. (2012). *Field manual of Michigan flora*. The University of Michigan Press, Ann Arbor.

NOTEWORTHY COLLECTION

THE DISCOVERY OF *RHEXIA MARIANA* L. VAR. *MARIANA* (MELASTOMATACEAE) IN NORTHWEST INDIANA

Scott A. Namestnik

Orbis Environmental Consulting

P.O. Box 10235

South Bend, Indiana 46680

snamestnik@orbisec.com

Significance of the Report. Prior to this collection, *Rhexia mariana* var. *mariana* had not been documented in northern Indiana or in the 22-county Chicago region, as defined in Swink and Wilhelm (1994) and Wilhelm and Rericha (2017).

Previous Knowledge. *Rhexia mariana* L. var. *mariana* (Melastomataceae), the Maryland meadow beauty (Figure 1), is a perennial herb of dry to moist sandy soil and full to partial sun conditions, occurring primarily in sandhills, savannas, flatwoods, meadows, marshes, ditches, bogs, edge of thickets, and upper shores of ponds and swales (Correll and Johnston 1979; Radford et al. 1968; Voss and Reznicek 2012; Wunderlin and Hansen 2003). It is one of several species with a core geographical distribution along the Gulf of Mexico and Atlantic Ocean coastal plains (in this case reaching from Texas to Massachusetts) and with disjunct populations around the Great Lakes (in this case in southwest Michigan prior to the recent collection) (Reznicek 1994); the core of the range of *R. mariana* var. *mariana* stretches inland to southeastern Missouri, southern Illinois, and southern Indiana (Kartesz 2015; USDA, NRCS 2018). Although it had not been documented from the 22-county Chicago region prior to this collection (Kartesz 2015; Swink and Wilhelm 1994), *R. mariana* var. *mariana* is extant in Allegan and Ottawa counties in Michigan, just north of the easternmost extent of the Chicago region (Voss and Reznicek 2012). In Indiana, *R. mariana* var. *mariana* was known from the southern third of the state, where it formed the boundary of the known core of its coastal plain distribution (Deam 1940; Kartesz 2015). Across its range, *R. mariana* var. *mariana* is globally secure (G5T5), but at the edge of its range in Indiana, it is critically imperiled (S1) and state threatened, and in the disjunct portion of its range in Michigan it is critically imperiled to imperiled (S1S2) and state threatened (IDNR-DNP 2016; Michigan Natural Features Inventory 2007; NatureServe 2017).

Discussion. A large, dense population of *Rhexia mariana* var. *mariana* estimated to include over 10,000 stems was discovered along the Calumet Bike Trail in a remnant mesic sand prairie within an overhead powerline right-of-way (Figure 2) in Porter County, Indiana in 2014. A brief search of the right-of-way and of the savanna and woodland in the immediate vicinity following the discovery did not result in the observation of any additional colonies of *R. mariana* var. *mariana*. This population is approximately 200 miles from the nearest Indiana



FIGURE 1. *Rhexia mariana* L. var. *mariana* along the Calumet Trail, Porter County, Indiana. Photo by Scott A. Namestnik.

populations at the edge of the core of the range of the species and is approximately 80 miles from the nearest southwest Michigan populations; as a result it helps to fill the gaps in the known disjunct range of *R. mariana* var. *mariana* around Lake Michigan. After becoming aware of this population, on October 6, 2018 Doug Botka located another population of approximately 90 individuals of *Rhexia mariana* var. *mariana* in adjacent LaPorte County, Indiana at $41^{\circ}42'49.67''$, $-86^{\circ}49'42.57''$, growing around the edge of an excavated pond with *Acer rubrum* L., *Coleataenia rigidula* (Bosc ex Nees) LeBlond, *Dichanthelium* ssp. (Hitchc. & Chase) Gould, *Euthamia gymnospermoides* Greene, *Frangula alnus* Mill., *Nyssa sylvatica* Marshall, *Osmundastrum cinnamomeum* (L.) C. Presl, *Oxycoccus macrocarpus* (Aiton) Pursh, *Pinus sylvestris* L., *Rhynchospora capitellata* (Michx.) Vahl, *Rubus* sp. L., *Schizachyrium scoparium* (Michx.) Nash, *Solidago rugosa* Mill., *Spiraea tomentosa* L., *Spiranthes incurva* (Jenn.) M.C. Pace, *Symphyotrichum praealtum* (Poir.) G.L. Nesom, *Toxicodendron vernix* (L.) Kuntze, *Vaccinium corymbosum* L., and *Vernonia* sp. Schreb. (D. Botka, personal communication, October 7, 2018 and November 7, 2018). These discoveries should encourage field botanists to conduct additional targeted surveys for *R. mariana* var. *mariana* in appropriate habitat in proximity to Lake Michigan. Field botanists in this region should also be on the lookout for species with similar ranges as documented by Reznicek (1994) that have not yet



FIGURE 2. Habitat of *Rhexia mariana* L. var. *mariana* along the Calumet Trail, Porter County, Indiana. Photo by Scott A. Namestnik.

been documented in northwest Indiana (such as *Bartonia paniculata* (Michx.) Muhl.).

Diagnostic characters. *Rhexia mariana* var. *mariana* is one of 14 taxa (not including hybrids) in the genus, which is nearly endemic to the eastern United States (*R. virginica* L. reaches into Canada, and *R. cubensis* Griseb. reaches into the West Indies) (Kral and Bostick 1969; Nesom 2012). The following characteristics (from Kral and Bostick 1969 and Nesom 2012) can be used to distinguish *R. mariana* var. *mariana* from the other taxa in the genus: the four petals are lavender-pink to white (not yellow as in *R. lutea* Walter); the anthers are 5–11 mm long and curved (not ca. 2 mm long and nearly straight as in *R. lutea*, *R. nuttallii* C. W. James, and *R. petiolata* Walter); the stems and leaves are pubescent (not glabrous as in *R. alifanus* Walter); the bracts are narrower than the hypanthia (not foliaceous and as wide as the hypanthia as in *R. parviflora* Chapm.); the hypanthia are up to 1 cm long (not over 1 cm long as in *R. cubensis* and *R. nashii* Small); and the stem faces are unequal, with two broader, darker green and convex, and the other two narrower, pale and concave (not equal and flat as in *R. aristosa* Britton, *R. interior* Pennell, *R. salicifolia* Kral & Bostick, *R. ventricosa* Fernald & Griscom, *R. virginica*, and sometimes in *R. parviflora*). The species to which *R. mariana* var. *mariana* is most similar are *R. interior*, *R. ventricosa* and *R. virginica*. Several characteristics can be used to distinguish *R.*



FIGURE 3. Stem and leaves of *Rhexia mariana* L. var. *mariana* along the Calumet Trail, Porter County, Indiana. Photo by Scott A. Namestnik.

mariana var. *mariana* (Figure 3) from *R. virginica*, including leaves (linear to lanceolate, to 11 mm wide, and short petioled in *R. mariana* var. *mariana* versus ovate, over 11 mm wide, and sessile in *R. virginica*), stems (blunt angled in *R. mariana* var. *mariana* versus strongly wing-angled in *R. virginica*), and flower color (white to pale pink in *R. mariana* var. *mariana* versus pink-purple in *R. virginica*) (Kral and Bostick 1969; Wilhelm and Rericha 2017); in addition, *R. mariana* var. *mariana* tends to grow in slightly dryer conditions and tends to flower slightly later than *R. virginica* (Voss and Reznicek 2012). The stems can be used to distinguish *R. mariana* var. *mariana* from *R. interior* and *R. ventricosa* (as noted above) (Kral and Bostick 1969; Nesom 2012). A variety of *R. mariana* with white petals and linear leaves, *R. mariana* L. var. *exalbida* Michx., is said to be distinct in portions of the range of the species, such as in North Carolina (Weakley 2015), but intergrades with *R. mariana* var. *mariana* are common, especially in regions between the extremes of the varieties (Nesom 2012).

Specimen citations. INDIANA. PORTER CO.: Calumet Trail. 41°40'4.7", -86°59'53.5". Rather dense population in mesic sand prairie located within NIPSCO right-of-way, just east of 5-mile marker on south side of Calumet Trail. More abundant in areas lacking *Solidago rugosa* and at slightly lower elevation than in immediately adjacent areas. Plants with buds, flowers, and fruit. Petals light pink (dried deeper pink). Associated species: *Achillea millefolium*, *Agrostis gigantea*, *Dichanthelium clandestinum*, *Eragrostis spectabilis*, *Euphorbia corol-*

lata, *Euthamia nuttallii*, *Galium pilosum*, *Hieracium kalmii*, *Juncus dudleyi*, *Juncus greenei*, *Lactuca canadensis*, *Liatris aspera*, *Linaria vulgaris*, *Lonicera* sp., *Melilotus albus*, *Panicum virgatum*, *Polygala polygama*, *Polytrichum* sp., *Potentilla simplex*, *Prunus serotina*, *Quercus palustris*, *Rubus baileyanus*, *Salix eri-ocephala*, *Schizachyrium scoparium*, *Solidago decemflora*, *Solidago juncea*, *Solidago rugosa*, *Spiraea tomentosa*, *Spiranthes cernua*, *Symphotrichum oolentangiensis*, *Symphotrichum praealtum*, *Viola sagittata*. September 13, 2014, Namestnik 2242 (BUT, MOR).

LITERATURE CITED

- Correll, D. S., and M. C. Johnston. (1979). Manual of the vascular plants of Texas. Second printing. The University of Texas at Dallas.
- Deam, C. C. (1940). Flora of Indiana. Department of Conservation, Division of Forestry, Indianapolis.
- IDNR-DNP. (2016). Indiana Department of Natural Resources—Division of Nature Preserves. Endangered, threatened, rare, and extirpated plants of Indiana. Available at <https://www.in.gov/dnr/naturepreserve/files/np-etrplants.pdf> (Accessed April 24, 2018).
- Kartesz, J. T. (2015). The Biota of North America Program (BONAP). North American plant atlas. Chapel Hill, North Carolina [maps generated from Kartesz, J. T. 2015. Floristic synthesis of North America, version 1.0. Biota of North America Program (BONAP). (in press)]. Available at <http://bonap.net/napa> (Accessed April 24, 2018).
- Kral, R., and P. E. Bostick. (1969). The genus *Rhexia* (Melastomataceae). Sida 3: 387–440.
- Michigan Natural Features Inventory. (2007). Rare species explorer (web application). Available online at <http://mnfi.anr.msu.edu/explorer> [Accessed April 24, 2018].
- NatureServe. (2017). NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, Virginia. Available at <http://explorer.natureserve.org>. (Accessed: April 24, 2018).
- Nesom, G. L. (2012). Infrageneric classification of *Rhexia* (Melastomataceae). Phytoneuron 2012–15: 1–9.
- Radford, A. E., H. E. Ahles, and C. R. Bell. (1968). Manual of the vascular flora of the Carolinas. The University of North Carolina Press, Chapel Hill.
- Reznicek, A. A. (1994). The disjunct coastal plain flora in the Great Lakes Region. Biological Conservation 68: 203–215.
- Swink, F., and G. Wilhelm. (1994). Plants of the Chicago region. Fourth edition. Indiana Academy of Science, Indianapolis.
- USDA, NRCS. (2018). The PLANTS Database. National Plant Data Team, Greensboro, North Carolina. Available at <http://plants.usda.gov> (Accessed April 24, 2018).
- Weakley, A. S. (2015). Flora of the southern and mid-Atlantic states. Working draft of 21 May 2015. Available at www.herbarium.unc.edu/flora.htm (Accessed November 6, 2018).
- Voss, E. G., and A. A. Reznicek. (2012). Field manual of Michigan flora. The University of Michigan Press, Ann Arbor.
- Wilhelm, G., and L. Rericha. (2017). Flora of the Chicago region: A floristic and ecological synthesis. Indiana Academy of Science, Indianapolis.
- Wunderlin, R. P., and B. F. Hansen. (2003). Guide to the vascular plants of Florida. Second edition. University Press of Florida, Gainesville.

NEIL ARTHUR HARRIMAN (1938–2018)

Just as this issue was going to press, we received word of the death of Neil Harriman, who served as editor of *The Michigan Botanist* from 1998 to 2005. Neil died on December 7 after an extended illness. He was born on August 1, 1938, in St. Louis, Missouri, where he grew up. He did his undergraduate work at Colorado College in Colorado Springs, Colorado, and received his Ph.D. in Biology from Vanderbilt University in Nashville, Tennessee, in January 1965. Neil joined the Biology Department faculty at the University of Wisconsin-Oshkosh in 1964, primarily to teach botany classes and do plant taxonomy research. Neil remained at UWO until his retirement in May 1998. In addition to his dedication as a teacher and his research, which resulted in the publication of numerous scientific articles, Neil grew the UWO herbarium from just a few specimens to its current size of 125,000. After his retirement in 1998, the university named the herbarium in his honor. We expect to publish a fuller account of Neil's life and work in a future issue of *The Great Lakes Botanist*.

—Michael Huft

REVIEWERS FOR 2018

I wish to thank the following people who reviewed manuscripts during 2018 for *The Great Lakes Botanist*. Their comments were important, both to the authors and to the editor, and their efforts, which are essential to maintaining the high quality of the journal, are greatly appreciated.

Dennis Albert
William C. Burger
Mark Dixon
Charlotte Gyllenhaal
Emmet Judziewicz
Daniel Kashian
Patrick Kociolek
Thomas Lammers

Julian Monge-Nájera
Anton A. Reznicek
Michael Rotter
Ryne Rutherford
Eliot Shubert
J. Dan Skean, Jr.
Bradford Slaughter